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ABSTRACT

In the first section of Volume II of this report, complete details are given concerning the background, goals, methodology, conclusions, and recommendations of a study evaluating eleven projects dealing with science education for minority students. Section 2 provides full descriptions for each of the eleven projects. Section 3 includes details of typical educational flow patterns for minority students and tabulations of recent science education intervention attempts. Finally, a project information checklist and lists of resource people and of published materials concerned with minority education are provided. (DT)

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An Analysis of Supported Projects to Test Methods for Increasing the Access of Ethnic Minority Students to Careers in Science and Technology

Volume II
Technical Report

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PREFACE

This final report "An Analysis of Supported Projects to Test Methods for Increasing the Access of Ethnic Minority Students to Careers in Science and Technology" is divided into two volumes as follows:

Volume I:	Executive Summary--provides a brief overview of the study's methodology, major findings, conclusions, and recommendations.
Volume II:	Technical Report--provides a full presentation of the study's background, goals, methodology, conclusions, and recommendations. Also included are full descriptions of 11 experimental projects designed to improve the access of minority students to science-related courses of study and a discussion of many other recent attempts to accomplish the same ends.

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Section I

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1. INTRODUCTION

Background and Purpose of the Study

In the late summer of 1973 the National Science Foundation announced plans to accept proposals for projects to test mechanisms designed to increase the participation of ethnic minority students in careers in science and technology. Responses to that announcement resulted, in late May and early June 1974, in the funding of 10 projects which planned to test various intervention strategies for improving the flow of minority students along channels which were likely to lead to science/engineering careers. The following year, grant money was again available and an eleventh project was funded. The Foundation's objective was to provide funds for the identification and demonstration of effective models which had a potential for broader use with minority students. The ultimate goals of the group of studies were to provide the educational community with a set of proven cost-effective mechanisms, and to provide the Foundation with guidance for future program efforts.

As a further step toward achieving its goals, the National Science Foundation contracted with the American Institutes for Research to act as the "third party" evaluator of the Foundation-sponsored projects. The objectives of the assessment were threefold:

--To provide a description of each project, covering goals, outcomes, procedures, applicants, participants, costs, etc., with the intent of assembling the experience of the various projects and making the benefits of that experience available to potential future projects.

--To carry out an analysis of the set of projects as a whole, specifically focusing on the potential of each project's intervention strategy for more general application.

--To make policy and administrative recommendations regarding future activities in this field including improved procedures for evaluating new proposals for experimental projects.

Work was begun by AIR in July of 1975 along two tracks. The first track was the documentation of the individual projects which ultimately involved visits to the project sites and extensive interviewing of the project personnel and participants. The second track involved efforts to provide a context against which the individual NSF-funded projects could be viewed by examining the experience of a wide variety of other projects and collecting background information related to general educational problems of minority students.

Operational Constraints

There were a number of constraints on this study which, necessarily, had an effect on the final outcome. While it is believed that the problems generated by those constraints have been largely overcome, the discussion and recommendations which follow in the body of this report must be understood in terms of the context within which AIR was working.

Constraints on Project Documentation

Of the original 10 project grants made in May of 1974, five were for 13 months or less, two were due to terminate in October, 1975 after 17 months, while three were to be carried out over a period of two and one-half to three years. Thus, when AIR entered the picture in July of 1975, nearly all of the projects had either been completed or were just winding up their activities. Most of the AIR field visits were carried out from October through the early part of December of that year, but by that time several key people were no longer associated with the projects and often the participants had dispersed very widely.

A second relevant factor is the extreme variability of methodology utilized by the individual projects: One attempted to impact on 20 students while another had its focus on the science classes at 17 different large high schools; a third project sought to affect the ultimate career choice of fifth- and sixth-grade youngsters, while a fourth dealt with community college pre-freshmen with an already expressed interest in engineering. Along the time dimension, planned participant contact with the projects ranged from three hours to three years.

Constraints on Background Information for Flow Pattern Construction

In trying to construct a general educational context for each of the minority groups involved in the 11 projects being studied, a number of difficulties were encountered, the greatest one being that certain desired information is simply not collected by any agency or any interest group. The accumulation of racial education data has been a very recent phenomenon and, while individual institutions have gathered such information over many years, it is only since about 1970 that EEOC requirements have prompted its accumulation on a national level. Further, minority groups other than Blacks have had a difficult time gaining representation as independent entities in these national surveys and the available data reflect that. Some studies report information for "White Students," "Black Students," and "Others"; while others identify subgroups as "White," "Black," and "Spanish Surname" without differentiating Americans of Mexican heritage from those with a Puerto Rican or other Spanish background. The data for native American students posed special problems because the Bureau of Indian Affairs of the Department of Interior and the Office of Education of the Department of Health, Education and Welfare utilize different criteria for defining who is a "native American." These two definitions result in strikingly different estimates of the total number of native Americans in the United States.

Despite these internal inconsistencies, an extreme effort has been made to gather and integrate the most recent and best information from a wide variety of both published and unpublished sources.

Caveats

This study brushes the fringes of several important areas which need considerable further elucidation. However, the scope of the present study was limited by time and by intent to the issues dealt with by the 11 research grants and to the elements in the context in which they operated. Thus, while this study has been concerned with documenting the education experience of minority groups, it has not attempted to ascribe causes of difficulties minority students may have faced nor is it able to propose remedies.

The special problems women have had in entering science and technological careers are not a subject of this study even though the proportion of minority women in those careers is much smaller than the proportion of non-minority women. None of the projects being evaluated addressed itself to sex differences and, though women were heavily represented in the programs at nearly all of the 11 project sites, no separate records were kept by any of the projects.

A word must be inserted here about the use of ethnic labels in this report. The term "Black" poses little difficulty as it is widely accepted and does not overlap significantly with other minority groups. The terms "native American" and "American Indian" seem to be used interchangeably in the literature though the latter term seems to be giving way to the former in the more recently published documents. The Spanish ethnic groups pose more of a problem. The term "Spanish American" is not much used now having been replaced in large part by the equally non-descriptive "Spanish Surname," under which title much data is still subsumed. Quite recently, the category has begun to be differentiated into "Mexican American/Chicano," "Puerto Rican American" (or more simply, just "Puerto Rican"), and "other Spanish speaking." This last category contains about one-third of the individuals included under the more general rubric, but their problems are not addressed in this report. "Mexican American" seems to be preferred over "Chicano," since many of those people object to being called "Chicanos" even though the latter term both predates the former in popular usage and is preferred among the younger members of the group. The term "Puerto Rican" will be used in this paper but will refer in this context to those people of Puerto Rican background presently living on the U. S. mainland.

There are special semantic difficulties when the accepted racial/ethnic designations are used in a comparative sense. For example, the majority group in the United States is termed "white" when compared with black, whereas it is called "Anglo" when it is compared with Mexican American people. Too, Puerto Ricans are also mostly "white" though a few are "black" and there seems little logic in differentiating Mexican Americans from "native" Americans on the implied basis of length of ancestral settlement in North America. Nevertheless, these terms will have to be used despite their imprecision because a more rational system of reference has not yet been evolved.

2. METHODOLOGY

This study was essentially analytic but also included some investigative and evaluative elements. The latter raised a major initial concern: The project grants from NSF had contained no admonition that the work was to be examined by an outside evaluator and it seemed likely that project directors would be disturbed by the prospect. This was expected particularly of those projects which had not been able to achieve all of their original goals, but seemed likely to be a disturbing element for any of the projects, since internal record-keeping and other documentation had not been carried out by them with an eye toward subsequent examination. Thus, one of the earliest of AIR's objectives was to create an understanding with the projects that AIR's efforts were oriented toward the future rather than toward the past. That is, the details of each project's experience were to be examined from the point of view of how that experience could help NSF and future projects.

The following steps were carried out as this study was conducted:

Task I--Project Familiarization

A meeting was held at the National Science Foundation between the AIR Study Director and members of his staff, and personnel from the NSF Office of Experimental Projects and Programs. Documents from each of the 11 project files were obtained and examined. These files typically included the project proposal, any interim reports that had been submitted, and copies of project-related correspondence including requests for NSF approval of changes in project personnel. Then, and many times subsequently, NSF staff made themselves freely available for consultation about specific elements of the projects and about the mechanisms NSF employs to advertise grant programs, process proposals, and monitor the grants.

A meeting was also held between AIR study personnel and project consultants from both within and outside of AIR to review the individual project plans, to outline sources of information related to the issues addressed in the projects (e.g., education problems of native Americans, experience with bilingual instruction, impact assessment in the educational setting, etc.), and to project probable ethnic sensitivities and concerns of those involved in the individual projects as either staff or participants.

A great many contacts were made in person, by telephone, and through the mail with people working with interest groups responsive to problems of the ethnic minorities represented among the 11 projects. This process was begun and had its greatest activity during the early phases of the study, but continued up to the date of this writing. The early results of this effort were the acquisition of a great many reports and studies related to the minority education experience.

Task II--Establishment of Cooperative Contact with Individual Project Directors

NSF had called a late August (1975) meeting in Washington of all of the Directors of the individual projects and studies. In early August, a letter was sent by AIR to each of the Project Directors outlining the scope and intent of the "third party" assessment and advising them that arrangements for a site visit would be made with them in the near future. The letter was followed up about 10 days later with a telephone call from the AIR Study Director to the Project Director at each site. The purpose of the call was to ascertain that the letter had been received, that there was an understanding of the basic purposes of the assessment, and to request that copies of project documents not already sent to NSF be brought to the Directors meeting for AIR's use so that site visit planning could be made more explicit.

At an early point during the two-day Project Director's meeting, the AIR Study Director made a formal presentation of the goals and plans of the assessment with emphasis on the potential application of experimental project strategies.

The result of these activities was that project personnel at all sites were most cordial and acceded to every request made of them, both at the time of the site visit and subsequently.

At this point in the conduct of the project, work began to be more clearly divided between project information acquisition and data acquisition for the "Typical Education Flow Patterns" being constructed to provide a context for the strategies being experimented with by the projects. In order to describe the tasks in their appropriate temporal sequence, project-related tasks will be listed with the designation "A" followed by flow pattern-related tasks with the designation "B."

PROJECT-RELATED TASKS

Task III-A--Determination of Essential Project Elements

The study's advisors and consultants were again convened and a draft Project Information Checklist was submitted to them for their comments. The checklist was intended for use as a reference during the site visits to make sure that all pertinent information was being acquired since it was not likely that any single individual would have all of the desired information at hand. The version of the Checklist included here as Exhibit 1 is the result of that meeting and was the form utilized during all of the site visits.

Task IV-A--Site Visits

Since nearly all of the projects had been in operation for a year and several had already been completed by the time AIR began its efforts, it was decided to arrange all of the travel so as to arrive at a site after the final data collection but before the report was written. AIR wanted to avoid interfering with evaluation efforts before post-testing was carried out, but felt that the project review necessary for AIR's benefit could be useful for the task of preparing the final report. There were two moderate constraints on the plan: The projects were spread across the country from Massachusetts to California and from North Dakota to Texas, so some regional grouping of visits was required to save travel costs. It also seemed desirable to be able to transcribe, review, and digest the information gathered from a small group of sites before travel was commenced to the next group.

A two-person team began site visits in early October and had traveled to nine projects by mid-December. The final two projects were visited in mid-February. An average of about five person-days was spent at each site.

The team's plan was to conduct extensive interviews with all persons associated with the project: administrative personnel, project staff, project participants, and individuals from outside the project who had had an impact on it. The object was to get as complete a picture as possible of the project's history and execution from various points of view so that in those circumstances which frequently arise where an event is interpreted differently by different actors in it, it would be possible to piece together a somewhat more objective description of those events. This objective was met, though it was more difficult than anticipated. Several key people had left the projects by the time of the site visit; three of those were interviewed in person during the course of other site visit trips and several others were interviewed by telephone. Ultimately, all key actors and all but a handful of secondary actors from among the projects' administrative staff were interviewed.

A more difficult problem arose with the interviewing of project participants. In those cases where participants were locally available, a satisfactory proportion of them were usually able to be interviewed. However, when participants had dispersed from the project site to individual high schools around the city or to universities in other states, the decision of whether or not to press for interviews was based on the judgement of the Study Director regarding the type of information obtainable and the difficulty of making the arrangements to obtain it. Thus, in the case of two projects where the participants had fleeting contact with the project inputs and a third where the participants were very widely scattered and knowledge of their whereabouts fragmentary, no interviews with participants were conducted.

The notes taken at each interview were transcribed as soon as possible thereafter, along with observations and other commentary, in order to capture the whole flavor of the project's physical situation and the personalities involved with it. In addition, numerous project documents were collected, especially those related to project formulation, evaluation and content.

Task V-A--Construction of Time-Lines and Milestone Records

The information gained from the site visit interviews and from project documentation was used as source material to construct time-lines and to evolve a list of project milestones. In several cases where inconsistencies existed or there seemed to be gaps in the information, individual project personnel were telephoned and the problems resolved. As could be expected, some projects progressed rather uneventfully from beginning to end while others encountered a large variety of difficulties at many points along the way. Those difficulties, and the attempts to resolve them, are a primary focus of this study.

Task VI-A--Acquisition of Late-Maturing Data, Etc.

During the site visits, wherever it was appropriate, arrangements were made for new data to be sent to AIR as they were acquired by the projects. Also, final reports and proposals for new, related projects were to be sent as they were produced. While considerable information has been acquired as a result of this arrangement, the response has not been as large as originally anticipated. One obvious reason for this is that nearly all of the projects are now ended and ex-project personnel are involved in new activities.

Task III-B--Determination of Critical Decision Points During the Course of Science/Engineering Education

The meeting of advisors and consultants described in Task II-A also considered the question of which choice-points in the education process of minority students were the crucial ones for inclusion in the flow diagram. That choice was tempered by the realities of information availability as it was then known to exist. For example, the number of people who elect science courses in high school would be a valuable figure to have, but such data are not collected separately for minority groups in very many high schools. The decision points ultimately decided upon were as follows: completion of grade 10 (normally prior to 16/17-year-old dropout), completion of high school, entrance to higher learning at either two- or four-year institutions, designation of a major in science/engineering, completion of second year of higher education, completion of third year of higher education, graduation at the baccalaureate level, entrance to graduate training, completion of graduate training at the master's level, and completion of graduate training at the doctoral level. In addition, it was decided that separate data would be sought for students who had experienced bilingual education in primary school and for Black students attending predominately Black institutions of higher learning.

Task IV-B--Accumulation of Minority Group Education Data

Utilizing leads supplied the project by its advisors and consultants as a starting point, AIR project personnel contacted education specialists from a large variety of special interest groups and government agencies, both in the Washington area and around the country. (A complete list of individuals and organizations contacted is attached as Exhibit 2.) Several problems with the available data arose immediately and, though special efforts were aimed at resolving them, they were never completely dispelled. For example, the post-high school academic experience of Native American students is not very precisely known for two reasons: (1) In many institutions of higher learning, the number of Native Americans in attendance is very small relative to the size of the student body and separate statistics are not kept for them as a group; and (2) native American students have a very high rate of dropout and drop-in. They frequently leave school to attend to personal or family matters for a period of weeks, months, or even years, returning to school when the problem is finally resolved. Few complete a college course in four years and reliable counts of what proportion eventually complete college are not available.

A similar problem distorts the count of Puerto Rican students in elementary, junior and senior high school where many are behind their age-grade due to language difficulties and other problems.

Task V-B--Revision of the Typical Education Flow Pattern Diagrams

An attempt was made to collect information related to each of the originally identified critical steps in the education process for every minority group involved in this study, but it became apparent that there simply was not enough information available about some of those stages to allow their inclusion in a sequential diagram. For example, the experience with bilingual education is neither long enough nor extensive enough to have prompted comparative data collection for bilingual and non-bilingual students. Too, the available information regarding the choice of a major field of study in college at the sophomore level proved to have less value to this study than originally expected because of the relatively large number of students who changed their original selection and the lack of specific information regarding the further educational experience of those students who identified themselves early as "science majors." In these major ways and in other minor ways the original plan for the elaboration of the Typical Education Flow Diagrams was changed to meet the realities of available information.

At this point in the temporal sequencing of the study, the two separate efforts joined.

Task VII--Integration of Other Studies Related to the Participation of Minorities in Science/Engineering Careers

Information was collected about a large number of other studies similar to the NSF-funded projects being assessed here in an effort to provide further context for the NSF projects and additional information related to the kinds of intervention strategies which seem to have promise for wider application. By far, the largest source of information about these additional studies was the American Association for the Advancement of Science bibliographic effort. AAAS was most cooperative and allowed AIR personnel to comb through their voluminous files for relevant project information.

3. DISCUSSION OF CASE STUDIES

As a direct result of the experience of the NSF funded projects, a number of issues arise which may have policy implications for NSF and which certainly should be considered by both the proposers and the reviewers of future research plans.

The single greatest project difficulty was an inadequate evaluation plan. In practical terms, an innovative intervention technique will get wider use only if other people can be convinced that potential results will be worth the effort. Without evaluation, there can be no clear idea of program effectiveness. It should not be concluded (as did the University of North Dakota and Olive-Harvey College) that the attainment of a desired outcome is due to project intervention if it is not known how the same (or equivalent) participants would have done without being exposed to project inputs. When relative effectiveness is unknown, it is not possible to weigh one potential technique against another and unless others can see that a program has utility, its fate is almost certain obscurity.

A few of the efforts in this study included no evaluation at all. Of those proposers who did attempt assessment, many did not try to identify and measure those outcomes which were most closely related to what the project was seeking to accomplish. Some recognized that it was important to establish "control groups," but frequently this was done by rote without enough consideration of the issues in question. Often, in such cases, the partial controls which eventuate from the broken research design can obscure, rather than elucidate, the impact of a project. The University of Michigan seems to have had that sort of experience.

It seems evident that it would be much to a potential project director's benefit to make some early decisions about which behavioral outcomes are expected as a result of a proposed input, what behaviors could be considered intermediate indicators of those outcomes, and which techniques can be used for measuring those behaviors. If such a self-examination were routinely incorporated in every proposal, it is likely that project quality would be substantially improved.

Even among those projects which scheduled evaluation, there was apparently little or no thought to an evaluation strategy. Far more than the mere detailing of the expected evaluation outputs and how they relate to the purposes of the project, the objective of an evaluation strategy is to choose the most central concern of the program effort, decide upon the behaviors most likely to be changed if program expectations are met, and make certain that an attempt is made to measure that change. For example, a critical objective of the Texas A. & I. project was to improve the quality of science instruction for Mexican American students through the special training of their teachers. Virtually all of the project's effort was directed toward the instructors, yet little attempt was made to determine the degree to which the participants incorporated the new elements into their contacts with their students.

The concept of an evaluation strategy also has implications for the point in time when the most vigorous evaluation effort should take place. Virtually all evaluation attempts among the present group of projects were of a short-term nature, but there are no good rules of thumb which can be used to relate the short-term success of an effort to mid-term success (not to mention "ultimate" success). An overall evaluation strategy would have helped the project planners to select that point in time when change was most likely to be related to the central concerns of the project so that impact assessment could be more meaningful. In the Texas A. & I. project, evaluation on a short-term basis (e.g., increase in the level of information of the teachers) would have been more appropriate than the intermediate-term assessment of student interests actually attempted, while for the University of Massachusetts, long-term evaluation was most relevant since the project diverted participants out of one success stream (vocational school graduation and immediate entry into a technical profession) into an engineering program where potential success was some years away.

This discussion does not imply that non-optimum evaluation should not be done or is of little consequence. On the contrary, in many cases intermediate measures are the only ones possible and nearly any well-thought-out evaluation attempt will yield pertinent information. But it should be recognized that the more remote an evaluation is from the optimum for a specific input, the less clear-cut the results are likely to be. The Los Angeles County project tested students as part of an evaluation of the county's counselor training project. In so planning, they ran a very high risk of short-changing themselves, since no matter how effective the counselor training program was, many kinds of intervening events could (and did) prevent the newly trained behavior from having an impact on the students being counseled.

* * *

The proposers of many of the projects failed to acknowledge the state-of-the-art of the various mechanisms employed in their planned intervention strategies. Summer training programs have been tried before in other contexts, special training sessions to sensitize people to various kinds of human relations issues have a long history in industry, there has been some experience with both filmed and live role models, and there is much information regarding filmed presentations of many different kinds of material. These are not project issues; they are pre-project issues, but few of the project planners based their utilization of these sorts of techniques on the lessons learned by others. From the point of view of both the proposed project management and NSF, it would seem to be most desirable to establish with some confidence that the vehicle is right for the purpose before entrusting it with valued freight.

* * *

Another major problem area among the studies in this evaluation has been that of project management. In several cases, major responsibility was delegated to individuals whose experience, however strong in some areas, did not prepare them for the overall coordination of a major research effort. This, by itself, is not necessarily bad if backup is provided, but in each of three cases (Michigan State University, Los Angeles County, and the University of North Dakota) the one person who did have a complete theoretical overview of the objectives of the project was not sufficiently available to the project coordinator to prevent those objectives from being lost from view amidst the day-to-day difficulties of establishing an operational program.

Very few of the project proposals included a clear delineation of what the project tasks were to be and who would be responsible for carrying them out. It would be beneficial to potential projects if proposals included this information in substantial detail. Lines of control and responsibility should be specified so that critical compromises are not made to the detriment of the ultimate project goals. When faced with problems, it is a natural reaction to abbreviate an effort in order to accomplish the possible, but from the research point of view, it matters little that films get produced, bodies fill seats, and classes are taught if these activities become detached from the research objectives.

* * *

Participant selection proved a problem for several of the projects. The efforts carried out at the University of North Dakota and at Olive-Harvey College during its second summer were critically hampered by the inability to recruit participants of the type they had been programmed to deal with. Each project was faced with a delayed start and elected to make concessions in the area of participant quality in order to increase the number of people with whom to carry out the program. In both cases, this decision led to a level of participant motivation which was much lower than expected, and this seriously affected the impact of the intervention techniques being tested.

Participant selection cannot be treated casually. The rationale upon which a project's effort is based determines whether participants should be an optimal group or a typical group. Since the project programming logically must be quite different to bring a substitute participant group with different credentials to the same ultimate point planned for the original group, substitute participants rarely work out.

* * *

Participant motivation is a strong factor related to the success of a project but it was largely ignored during project planning. Many things can be motivating and different things motivate different people, but psychology has developed a few rules-of-thumb which can be useful guides. For example, near-term rewards are more motivating than distant ones, rewards related to strong desires are more motivating than rewards related to weaker desires, and rewards related to goals people set for themselves are more motivating than rewards associated with goals set for them by others. The University of Massachusetts found that a student who has a strong desire to attend college but who cannot afford to do so can be motivated to invest an extraordinary amount of energy by the reasonable possibility of being granted a scholarship. On the other hand, a student who is not convinced that college attendance would be beneficial perhaps cannot be motivated at all by the same promise.

Real life and real projects are rarely as clear-cut as described above, but formal project consideration of the motivating influences at play in a given project situation would help to avoid the expenditure of money and effort when an analysis shows motivation is likely to be very weak.

* * *

Since it is clear from the experience of these eleven projects that the success of an intervention strategy is by no means assured, it seems imperative that when students are to be directly impacted by an attempt at intervention, the proposal discuss the possible consequences to the student of project failure. These consequences would seem to be of different orders of magnitude depending on which of two general categories the project effort falls into: attempts to conserve within the science pool students who otherwise would be expected to drop out, and attempts to stimulate students to consider science subject areas who otherwise might not do so. There are different things at stake in the two types. Conservation implies remediation of elements in a participant's background which have been deemed ineffectively learned. The process of identifying those elements carries some taint of "failure" to the participant. Under those circumstances, it seems especially important for a project to provide the participant with a situation in which success is probable, because continued failure, especially under the protective umbrella of a "special project," could be devastating to any hope a participant might have of entering a science profession.

The "mastery learning" concepts planned for the first summer program at Olive-Harvey College promised to provide just such a success environment, while a failure environment is characterized both by the University of North Dakota effort, where the frustrated participants stopped attending classes well before the summer session was complete, and by the experience of the participants in the second Olive-Harvey summer program, where all but four of them received a failing grade in at least one of the special courses. It is possible that the maximum negative effect on these students will be that they reconsider their desire to enter a scientific field. It is also possible that a few have been dissuaded from attempting to gain a post-secondary education of any kind.

The stimulation of new science interest implies a controlled environment in which many of the usual consequences of individual failure are absent or reduced in impact. Colorado State University is attempting just that and, to a much less complete degree, so did Los Angeles County. In the latter project, the students were obviously no worse off for not having had the opportunity to view the role-model films and, in these circumstances generally, project failure would seem to have much less adverse impact on participants since their experience would be to miss out on an "extra" rather than to fail at something "essential."

* * *

The experience of several projects in this study raises a question: Can educators be expected to change their accustomed behavior for a special purpose? Realistically, within the limitations of projects of the present scope, the answer seems to be "no." At least, the four projects which tried to do so had very little success and two other projects, specifically recognizing the difficulties, opted not to try. The University of North Dakota was not able to get its cooperating instructors to change their preconceived teaching plans to fit the special needs of native American students. Olive-Harvey College, despite a special training session for its instructors, was not able to get them fully to carry out mastery learning principles. UCLA had great difficulty persuading its cooperating high school teachers to alter their standard study plans to take into account the experimental half-sized classes and teaching assistants. Los Angeles County, though it did provide some valuable inputs during its training sessions, apparently was unable to convince any of the counselors to change his or her counseling style materially.

Both Texas A. & I. and Colorado State University approached the issue obliquely. In Texas, the stated intent was not "teacher training" but a science activities workshop designed to ease the teachers' operational problems. The Colorado State University project avoided the difficulty altogether by assuming that high school counselors were doing the best they could within the circumstances in which they had to work and setting up a project which supplemented counselor inputs with outside resources and personnel.

The argument here is not that it is impossible to convince educators to change the way they carry on their professional duties; rather, for a variety of good, practical reasons (including the temporary nature of an experimental project) it is very difficult to do so. Thus, projects which propose this sort of behavior change as a crucial element should be appraised with skepticism.

* * *

None of the projects experienced much difficulty linking with outside elements. Teachers contributed time, school principals allowed the use of their facilities, guest speakers made appearances (sometimes traveling long distances to do so), and student trips were arranged, all with relative ease. The experience argues for the inclusion of this type of element in a project without a qualm whenever it seems appropriate to do so. However, there is one caveat: When a project requests free assistance from outside individuals, as is frequently the case with teachers or counselors, their enthusiasm and cooperation are likely to waver unless the project provides compensating benefits. The Michigan State University project experienced this even though they were making a nominal payment to the cooperating teachers for their "time."

Two projects produced films as a basic component of their intervention strategy. In both cases (Michigan State University and Los Angeles County), the impact value of the films was not able to be assessed, partially for reasons related to the film production itself. More than $52,000 of NSF grant money was spent on production costs (not including project personnel salaries or associated costs) and this sum is larger than the overall budgets of five of the 11 projects. The outcomes of this expenditure are elegant products of high technical quality which were used once for the purposes of the project which produced them, but because their impact is unknown, are likely to have very limited utility in the future. Film-making is complex and very costly and, given the problematic outcome of any research project, it is questionable whether scarce research funds should be utilized in this way.

4. RECOMMENDATIONS

Based on the totality of the experience of the individual projects with the strategies they attempted to execute and with their relationship with the National Science Foundation, the following recommendations are made:

NSF Policy Recommendations

- *The National Science Foundation should continue with an expanded experimental programming effort in the minorities area provided that project quality can be raised to the point where answers to a number of pressing questions can legitimately be expected to be answered.* The experience of the 11 projects in this study and a review of the descriptions of science education projects for minority students assembled by the Office of Opportunity in Science of the American Association for the Advancement of Science make it clear that very little is presently known about the mechanisms which are useful for improving the access of minorities to science careers. A large part of the problem up to now has been that most intervention attempts have been carried out without a proper evaluation of their accomplishments. NSF, by funding an improved quality of project (specific recommendations for project improvement are given below), could make a signal contribution to the state-of-the-art.

- *If minority funding of the present variety is to be continued, NSF should substantially broaden its dissemination of funding availability information.* The present program effort seems not to have attracted many proposals from minority researchers. Indeed, of the four minority group project directors involved in the present series, three learned of NSF's minority programming purely by chance. Further, two of the 11 projects would appear to have been marginal prospects for funding under this particular category. The Stanford University project breaks important ground but would not seem to be designed "to test mechanisms . . . (for) increasing the flow of ethnic minority students into careers in science." The University of Michigan project received funding for a rerun of a successful program it had initiated the previous year. This is not meant to detract in any way from the work that was done on these projects, it is merely to underscore what appears to be a very weak response to the NSF program announcement from the smaller colleges, from institutions which are oriented primarily toward minority students, and from minority researchers, wherever they may be located. In industry, equal opportunity employers have found new and effective ways of advertising jobs so that minority group members have a much greater chance of competing successfully. The National Science Foundation should take the same stance with regard to its own programming. Modes of information dissemination aimed specifically at minority channels of communication could be expected to generate a larger number of potentially fruitful project ideas.

- Whether or not minorities are involved, if this general type of project is going to be encouraged, *NSF should allow itself to move into a more cooperative relationship with individual projects starting at an early stage in the funding process.* Judging by the 11 projects reviewed in this study, NSF's sink-or-swim stance of non-involvement with the projects it funds allows many good ideas to go under for reasons unrelated to the theoretical considerations being tested. While the grant relationship prevents NSF from active participation in a project, the Foundation can and should make itself more of a resource in a variety of ways. Several are suggested below under "Administrative Recommendations."

Administrative Recommendations

- *To help reduce the number of proposals with good ideas but weak execution, NSF should develop a kit of explanatory materials which would be available to anyone upon request and sent automatically to those whose pre-proposal ideas are deemed worthy of pursuit.* In the minorities area, NSF is dealing with a population of proposers who are not necessarily experienced planners, budgeters, or researchers. But they are dedicated and they are fully familiar with the strengths and limitations of their potential project participants. A kit of materials which clearly and completely describes the elements of a successful proposal and which also provides suggested formats for budgets, allocation of personnel resources, evaluation strategies for various circumstances, and the like, would be of enormous benefit to those people.

- *NSF should provide technical assistance to the authors of promising pre-proposal ideas where that is needed in order to produce a fully articulated final proposal for NSF's consideration.* Many of the difficulties encountered in the execution of the 11 projects included in this evaluation could have been anticipated had some of the standard project planning mechanisms been employed by the project originators. It would be of great benefit to the projects actually funded and, no doubt, cost-effective in terms of project success, if NSF could supply an experienced project planner to work with a proposer in the elaboration of the proposer's basic ideas. Where a proposal seems to have few difficulties, supplementary work could be done at very low cost by telephone, but where the proposal idea seems to be fruitful but ill-explained, it might be necessary for an adviser to make a brief site visit of one or two days for working meetings. The National Institutes for Mental Health, Center for Minority Group Mental Health Programs presently has such a program in operation. They arranged a pool of consultants with a variety of expertise and assign them to proposals which fall in areas of targeted priority. The consultants can be utilized by both minority and non-minority proposers, but special efforts have been made to advertise their availability through minority newsletters and professional organizations. As a result of this effort, NIMH reports that the quality of funded programs has increased.

- *NSF should improve materially the amount of communication between itself and potential grantees so that appropriate planning can be carried out by them and realistic expectations maintained.* The difficulty of obtaining information about the status of their proposal was a constant irritant to nearly every project director contacted in this study. At most of the project sites, AIR was specifically told that funding had been expected much earlier in the year than it arrived. It is not clear how the project directors reached that conclusion, since there does not seem to have been any communication from NSF regarding the approximate date of expected funding or the length of time NSF needed to process grant requests. Nevertheless, important decisions were made on the basis of supposition and belief which could not be clarified with NSF. It was especially exasperating to some projects when their first knowledge of NSF funding came from sources outside of the Foundation and then project start-up was further delayed when official notification of funding became caught up in the bureaucratic tangle of their own institutions. As pointed out in the text of this report, many projects were injured by this sequence of events; one or two, perhaps, fatally.

The above recommendations concern the general stance of NSF vis-a-vis the individual projects it funds. Below are several recommendations for administrative changes which will serve to raise the overall quality of the projects considered for funding.

- *NSF should insist on high-quality proposals which meet stringent criteria of completeness and which effectively treat the several critical project areas.* Planning, participant selection, evaluation, and consequences of project failure are all essential elements in a proposal of this sort and none should be slighted. Among the 11 projects already funded, NSF made decisions regarding several on the basis of strong but incomplete proposals. As mentioned elsewhere, evaluation was often weak, but once NSF passed positive judgement on the overall proposal, there was not much new thought given to the individual elements.

- *NSF should include an evaluation specialist on every peer review committee.* An individual with field-implementation experience would be a significant asset to the review committee and his or her presence would undoubtedly result in an overall improvement of project quality.

- *NSF should establish a mechanism for conditional approval of project proposals pending receipt of supplementary materials designed to eradicate specific deficiencies in the original proposal.* Such conditional acceptance would make it largely unnecessary to proceed with the funding of a substantially acceptable project which, nevertheless, includes elements which are obscure. Among the 11 projects in this study, the greatest single difficulty was inadequate planning for evaluation of the project's impact. The proposers were all intelligent people with good ideas, but they lack experience with impact assessment. These people would appear to be typical of the population of proposers NSF would be dealing with in program areas of this sort and it seems a bit unrealistic for NSF to demand evaluation sophistication of people who are not social scientists by profession. On the other hand, a project which lacks evaluation is of very little use toward furthering the understanding of effective intervention strategies. A conditional acceptance would let the proposer know that the project is being seriously considered for funding and would allow the proposer to repair weak sections in order to meet acceptance criteria. This mechanism would result in the strengthening of many projects and thus increase their probability of successful completion.

- *NSF should set aside some portion of its grant funds for contingency awards.* This would serve two purposes. Since NSF's policy is to fund innovation but not implementation, and since proposers of projects are interested in implementation as well as innovation, some small additional funding for the further exploration of promising techniques would serve the purpose of bridging a time period during which the project director could search for local support for carrying out his or her ideas. Under the present circumstances, this is very difficult because the typical year or 18-month funding period is usually too brief a time to gain a sense of the quality of the innovative technique, develop new ideas, and apply for renewed funding from other sources in time for project continuity to be maintained. The second benefit of contingency funding is that NSF would be able to pursue interesting approaches by providing support for follow-up studies and longer-term evaluations.

The totality of the project experience and the general state-of-the-art in the area of minority education suggests several directions for new programming which NSF might pursue:

1. The Foundation should consider coordinating the funding of, or actually funding, a major high-level national effort to acquire and maintain a head count, on a grade-by-grade basis, of students from all minority groups which have special education problems, either nationally or regionally. This would provide a basis for policy-making, for the expenditure of funds, and the building of programs to facilitate the participation of those minority students in careers in science and technology. There is a long litany of basic information about minority students which is needed but unavailable: The education problems of native Americans in urban settings are largely undocumented; the extent to which Mexican American and Puerto Rican students are behind their age-grade can only be guessed at using grouped census data now many years old; the shifts in

popularity of community colleges and four-year institutions have great implications for the training of minority students, but few records beyond the gross numbers involved seem to be kept; almost nothing is known about the degree to which minority students are electing to major in science or engineering courses during their college careers, and still less is known about the relative success of those science majors as they progress through baccalaureate and graduate training; minorities' experience in community colleges, their rates of successful completion, and their rates of transfer to four-year institutions are all a mystery. Light in any of these dark corners would be welcome; a major effort would be of immeasurable assistance.

2. NSF should find ways of emphasizing intermediate science careers during a student's high school years in order to alleviate the all-or-none concept of science which is very generally held by minority and non-minority students alike. Virtually all science information available (and virtually the sole focus of the 11 projects in this study) relates to the top science careers--the physicist, chemist, biologist, engineer, etc.--rather than to the middle-level jobs, such as lab technicians, jobs in the health fields, and others. A lack of role models is often identified as a contributing factor to minority students' relatively small representation in the science fields. Emphasis on intermediate careers could well encourage many more students to pursue science interests and thus rapidly increase the number of those who can call themselves scientists.

3. NSF should explore the effect of early and substantial career counseling on the science choices of students over the long term. A large proportion of students come to a decision about career choice before entering high school; minority students seem to come to a decision at a later point, but this may be due partly to their relative lack of career information. For the latter, by the time choices are made, it is often too late to take the required science and mathematics courses necessary to pursue a technical interest.

4. The National Science Foundation should explore the role of community colleges in the preparation of science students. Large proportions of minority students attend junior or community colleges but very little is known of their fate except that most don't finish and relatively few (compared with four-year institutions) elect science as an academic major. The community college is playing an increasingly major role in education and it seems essential to know what part is taken by its science departments.

5. While some longitudinal research has been carried out by NSF and other agencies, additional work in this area is very much needed. Very little is known about how science choices are made by minority students and there has been virtually no longitudinal follow-up of participants in specialized programs of a nature similar to those in this study.

Section II

5. CASE STUDIES--INTRODUCTION

The case studies found in the following chapters describe a number of different kinds of attempts to intervene positively in the usual education process of minority students in an effort to promote their greater participation in science activities. Three of the projects (UCLA, Colorado State University and Temple University) are multi-year efforts and have not yet been completed. The case studies for those are necessarily abbreviated in this report, but they will be supplemented when the projects are concluded. Two programs, those at Texas A. & I. University and Stanford University, were directed at elementary school children while the other nine were aimed at students who were attending or had just completed high school. Of the latter, five projects sought to influence students' choice of high school science subjects, and the remaining four offered specialized training leading directly to college acceptance.

Though there are some similarities of approach across projects, e.g., summer programs, career knowledge enrichment, or pre-engineering training, it seemed more appropriate to arrange the studies according to the general age-range of the minority students involved. This arrangement parallels the education process and results in a progression of projects from those which attempt a general stimulation of science interest to those which have a much more specific and limited goal.

The objective of the case studies is to highlight the experience of the 11 projects so that it can be of benefit to future projects in this or similar areas of involvement. To accomplish this, each project is discussed critically from the point of view of the adequacy of the methodology utilized to reach its stated goals and the quality of the procedures used to evaluate the impact. While all of the projects had many positive elements, much of the discussion in the case studies centers around problem areas, especially those common to many of the efforts. It is specifically emphasized that it was not the purpose to judge the overall quality of the projects reviewed, rather it was to identify and comment upon those elements which seem to have been crucial to project success.

6. CASE STUDY--TEXAS A. & I. UNIVERSITY

"Developing Science Career Interest in Bilingual, Mexican-American Elementary Students"

June 1, 1975--May 31, 1976

Original Brief Description

This experimental project is designed to increase the interest in careers in science for upper elementary (grades 5 and 6) Mexican-American students who are bilingual (speak Spanish as a first language). It attacks the problem by stressing the development of bilingual science teachers in the 5th and 6th grades. Teachers in the project will be given training in a Summer Workshop to increase their knowledge of general science, to develop strategies to teach science bilingually, and to increase their awareness of career opportunities in science, especially those available within the geographical area in which they teach. In-service training throughout the following year will provide for continuous development of bilingual science teaching strategies, as well as for the development of the counseling skills required to help inform these minority students about the potential of, the educational requirements for, and the life and work styles of careers in science.

The program will be evaluated by comparing the science achievement test scores, grades, and interest in science careers of the upper-elementary students who are taught science bilingually to measures from a control group which received science instruction in the traditional manner.

Seventeen 5th-and 6th-grade teachers of bilingual students participated in a summer workshop and subsequent in-service training which appears to have changed the attitudes and associated behaviors of most of them regarding the teaching of science. Though a few of the bilingual instruction elements of the project could not be carried out, a rich variety of programming generated great enthusiasm and brought many novel science teaching ideas to the 5th- and 6th-grade classrooms.

Project Personnel

Administrative Staff:

Robert Warren*	Project Director Assistant Professor of Education Texas A. & I. University Kingsville
Paul Bryant	Project Co-Director Assistant Professor of Education and Chairman of the Counseling and Guidance and Preparatory Program Texas A. & I. University Kingsville

Instructional Staff:

Manuel Salinas, Jr.	Assistant Chancellor Texas A. & I. University Kingsville
Salvadore Alvarez	Director, Bilingual Education Program Texas A. & I. University Kingsville

Teacher Participants:

Louella Daugherty	Sixth grade teacher Ingleside Junior High School Ingleside
Rhonda Fogel	Sixth grade teacher Colston Elementary School Kingsville
Ruben Gonzales	Sixth grade teacher Effie Hutto Elementary School Robstown
Minerva Gracia	Fifth grade teacher Tuloso-Midway Junior High School Corpus Christi

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*Individuals whose names are underlined have been interviewed.

Joy Graham	Sixth grade teacher Hebbronville Junior High School Hebbronville
Aurora Hinojosa	Seventh grade science teacher Memorial Middle School Alice
Gerry Kuntscher	Sixth grade science teacher Riviera Junior High School Riviera
Octavio Laurel	Sixth grade teacher Central Elementary School McAllen
Thelma Laurel	Sixth grade teacher Lincoln Elementary School McAllen
Linda Lawrence	Fifth grade teacher Beeville Junior High School Beeville
Carole Nix	Fifth grade teacher Colston Elementary School Kingsville
Raul Ortiz	Sixth grade teacher Benavides Elementary School Benavides
Earl Rackley	Sixth grade teacher Taft Junior High School Taft
Janie Rodriguez	Fifth grade teacher Ricardo Elementary School Ricardo
Rosalio Rodriguez	Sixth grade teacher Flour Bluff Intermediate School Corpus Christi
Paulette Whatley	Sixth grade science teacher Gillette Middle School Kingsville
Edna Ybarra	Fifth and sixth grade teacher Santa Gertrudis Elementary School Kingsville

Student Participants: There were approximately 1,000 experimental and control student participants involved in this project, but none were interviewed because there was no way they could compare the experience that they had with the experience they might have had if their teachers had not participated in the special science training.

The Context

Robert Warren, the originator of this project, has a background which includes the teaching of high school science for a six-year period just prior to receiving his doctorate in educational administration. He then joined the faculty of Texas A. & I. University at Kingsville and there he found that the problems of bilingual students were a major concern of both the university and the public schools in the area. He developed and carried out a project related to science in junior high school which sought to improve the quality of science teaching by means of a summer session. Through that project, Warren discovered that a great many of the teachers in elementary schools were very much unprepared to teach the science sections required of them since most had had virtually no science during their own training.

Texas A. & I. University has, over the past several years, become a center for bilingual education. A bilingual specialty was added in 1972 with Salvador Alvarez as its director and there now are programs at both the masters and PhD levels. Through the Bilingual Education Program, a very large library of Spanish materials has been built up and has become an important resource for all those interested in bilingual education.

Paul Bryant, the Chairman of the Counseling and Guidance Certificate Program at Texas A. & I., had noted that the earliest counseling of students in Texas takes place mostly at about the 11th grade level, but by that time most people have already made up their minds about whether or not they are interested in science based on their experience to that point. With elementary school science being taught so superficially, few students had much exposure which might generate interest, but the bilingual students (the majority at many schools in the whole southern region of Texas) had special difficulties because science terminology was difficult for them and because science concepts were not a part of their everyday experience. The result had been an exceptionally low frequency of Mexican-American students from the area becoming interested in the science and engineering fields.

With these as background factors, Warren (with Bryant) became interested in conducting a science education program which would benefit bilingual and other elementary school students in a manner which would be self-sustaining rather than just temporary. They chose to work with 5th and 6th grade teachers because the 5th grade is the point at which science is begun to be taught every day rather than just once a week.

Project Milestones

1974	
October	NSF Minority Program brochure seen by Warren.
Mid-November	Warren submits three-page research plan to NSF.
December 30	NSF sends letter to Warren encouraging a formal proposal.
1975	
January 28	Warren submits a full proposal to NSF.
Mid-February	The NSF review panel meets to consider the proposals received in this funding category. Texas A. & I. proposal is recommended for funding.
Mid-March	Warren is pressed to fix his own summer teaching schedule so he calls NSF to try to find out when award decisions would be made. He is told that awards would be made in mid to late May.

1975

Late March	Warren, assuming that any possible NSF funding would not be timely, schedules his own regular summer courses. Alvarez also accepts a summer position on campus.
April 28	NSF sends a letter of award to Dr. James C. Jernigan, Chancellor, Texas A. & I. University, Kingsville. This letter was never received.
April 30	Warren receives a letter from his Congressman with a copy of a telegram congratulating Texas A. & I. University on the award of a grant from the National Science Foundation.
Mid-May	Warren still has not heard from NSF, so telephones them and is told that a grant is not official until he is notified by the NSF Business Office.
Mid-May	Warren calls the NSF Business Office which reports that a letter of award has been sent.
Mid-May	The Texas A. & I. Business Office, not having received the letter of award, checks with the NSF Business Office which promises to send a duplicate letter.
Mid-May	Duplicate letter of award is received by Texas A. & I.
Mid-May	Warren makes the decision to shift the proposed program from the first six-week summer session to the second.
Mid-May	Recruiting begins for teachers from area schools.
Late May	Public schools close for the summer.
June 2	First summer session begins at Texas A. & I.
July 14	Second summer session begins at Texas A. & I.
August 22	Summer session ends
Late August	Public schools begin sessions
Late September	Pre-measures administered to 5th and 6th grade students.
September-May	Saturday in-service meetings every three to four weeks during this period.

1976

May	Post-measures administered to 5th and 6th grade students.

Critical Steps

Program Definition

The project's objectives were to increase the knowledge of general science of the participating 5th and 6th grade teachers, to guide them in the development of strategies to teach science bilingually, and to increase their awareness of career opportunities in science, both within the geographical area in which they teach and more generally. To carry this out, it was felt by Warren to be important that the project not attempt to "teach" science. Since all of the participants were going to be experienced instructors, Warren thought they might well resist any attempt to retrain them, as that would be an implied challenge of their professional qualifications. Thus, the underlying intent of the project was to get the individual teachers personally excited about science and about the kinds of science-related things which could be accomplished in the classroom.

Program Planning

It was important that the project reach experienced elementary school teachers since those were the people who were most likely to feel secure enough in their own abilities to try out new approaches. A decision was made that the project would be operated within the familiar professional context of the summer extension course and in-service training. Thus, it was arranged that the university would grant normal course credit toward a graduate degree for the project instruction. In addition, the project would pay a daily stipend in lieu of earnings, since many potential participants would normally need to be employed for the summer,

The late start of the project caused some reorganization of the original plans for participant recruitment and the physical support for the project at the university. By the time the project could officially begin, classroom space and university transportation had already been committed for the summer and alternative arrangements had to be made. Warren approached those problems flexibly, found out what resources were available, and utilized them as best he could.

The familiar university course context made the budgeting of time and personnel relatively simple. That task was further aided by the fact that the project had been well thought through and segmented into phases, each with its own specific objectives, time schedule, and personnel responsibilities.

The proposal included the idea of both a short-term and a long-term evaluation of student response to the instruction carried out by the teacher participants. For each participant's class, a comparable "control" class was to be selected. The short-term evaluation involved the comparison of experimental and control students' scores on an interest inventory, a general achievement test in science, and science grades. No detailed plans were made for long-term evaluation as no funding had been requested for evaluation beyond the closing date of the project. However, a number of possible measures were noted in the proposal.

Unfortunately, there was no evaluation projected to assess the impact of the project on the teacher participants. While a "survey" of the teachers was planned following the summer workshop and again at the end of the full-year program, the issues of interest were not detailed in the proposal. It is apparent that not much consideration had been given to this element.

Staff Selection

There was only one staff member "selected" in a formal sense since the others involved with the project had been university faculty who had participated in the project's planning stages. However, when NSF funding was delayed past the time when normal summer programs had to be determined, Salvador Alvarez, who was expected to provide the project's bilingual elements had to commit himself to other summer work. Then, when funding for the project was received, Warren had to find someone who could make the bilingual inputs. His efforts to secure a consultant failed, but Warren finally was able to make an arrangement whereby Alvarez would spend a couple of days with the project and another person, Manuel Salinas, who had been involved with the migrant education program at the University, would also devote a few days of his time to the project.

Participant Selection

By the time that news of the funding of the project was officially received at Texas A. & I., only a week remained before the public schools closed for the summer. Warren knew that by that point nearly all of the teachers would already have had summer commitments, so he initiated a search for participants which was designed to recapture the same type of teacher who might have applied for the program had funding come earlier: Information about the summer program was telephoned to the principals of each of the elementary and middle schools in the area which had a bilingual program or a large Spanish-speaking attendance; two special programs at the university had many more applicants than space, so the rejection lists were obtained and individuals named were sent descriptive material along with NSF project application forms; and recruiting was carried out in the university education classes during the first summer session with the expectation that there were many teachers from the surrounding area who were taking courses toward a master's degree and who had not yet committed themselves for the second summer session.

The recruiting effort resulted in 27 applications of which 20 were accepted. (Rejected applications were from individuals who taught below the 5th grade level or who had few bilingual students.) Of the 20, three people dropped the course almost immediately for reasons not associated with the project and one additional person was enrolled late. Interviews with the teacher participants disclosed a variety of motivations for signing up for the program, but the predominate ones were a recognition that their ability to teach science was very limited and a hope of acquiring new skills. Most had had only two or three terms of science during their own education. One participant spoke for several others when she said that she had been "scared to death of science."

Programming Activities

The project included two training phases, one of which was the summer workshop (for which six graduate credits were given) and the second was the series of in-service training meetings carried out during the course of the school year (for which an additional three graduate credits were awarded).

Of the 17 participants, 10 were bilingual, one spoke Spanish fairly well but was not bilingual, and six spoke no Spanish at all.

During the summer workshop there was great emphasis on the science resources available to the teachers including science materials in Spanish which could be borrowed from the Texas A. & I. Bilingual Library, resources provided by the state (including a Live Materials center which could supply fish and small animals for no more than the cost of transporting them), and the major national science curriculum centers and publishers. In addition, the participants were taught how to perform basic science experiments in the classroom with commonly-found materials, and how to construct simple teaching aids and class projects (such as milk carton periscopes).

The project utilized a number of guest speakers. A Texas A. & I. professor talked to the teachers about the relationship between science and agriculture, the telephone company sent a representative to explain the use of lasers and other space-age equipment, and the University photographer showed the teachers how to make photographic slides using commonly found school equipment, then helped them to put together a slide show from pictures in books and other materials.

The participants were also taken on several field trips. One was to the Corpus Christi Naval Air Base where they toured the weather forecasting facility and the airport control tower. Another trip was made to the wildlife preserve where animals could be seen in their own habitat and where conservation efforts were explained. They also visited the Corpus Christi Museum where, by chance, they were able to participate in the cleaning of some prehistoric mammoth bones which had been found by the museum. The participants spent a memorable two hours with tooth brushes and learned that museums have very interesting back rooms.

It was made clear to the participants that nearly all of the guest speakers were available at no cost to give talks to school classes and that arrangements could be made easily for school trips to any of the project trip destinations.

The bilingual education inputs to the project turned out to be fewer than had been planned. Alvarez conducted three 3-hour sessions which focused on the language difficulties faced by bilingual students with special emphasis on those structural aspects of English and Spanish which cause the children the most difficulty. He pointed out, for example, that there is no way of asking "why?" or "what?" in Spanish. Therefore, Spanish-speaking students usually tune those words out of things they hear. In addition, since even the bilingual teachers were not usually familiar with the Spanish rendering of scientific terminology, a number of rules-of-thumb were presented for converting English words to Spanish words. Though neither the English nor the Spanish term might be known by the bilingual student, the Spanish rendering would make it easier for the student to remember. Finally, the participant group itself was used as a resource by dividing it into subgroups which then recorded both English and Spanish taped commentary for the slide shows produced by the participants as a class project.

The in-service training series of meetings during the course of the school year were devoted primarily to the sharing of experiences as the participants tried out various things they had learned during the program. In addition, there were discussions focusing on the counseling of bilingual students and the further refinement of bilingual science activities based on the students' needs. The key objective of the in-service training portion was to provide encouragement to try out the various science activities introduced during the summer program.

Program Evaluation

At the beginning of the public school year in the fall of 1975, 20 additional upper-elementary science teachers were selected from within the same school districts the project participants had come from. As far as possible, attempts were made to match each experimental teacher's class with a control teacher's class at the same school so that factors like general socio-economic background, teachers' access to science materials, and the emphasis on science within the school would be approximately equivalent. Class size varied between 25 and 28 students, so there were approximately 500 students each in the experimental and control groups.

The evaluation instruments were of two types: an interest inventory and a general achievement test in science. The Kuder General Interest Inventory was used with the 6th-grade classes and the Science Research Associates "What I Like To Do" test was used with the 5th grade. The achievement test included both items from the Stanford Science Achievement Test and items which the teacher participants, themselves, had written.

For the achievement test, the teachers were asked to write questions of the type they would use in their own classes. Then, 30 of the best were selected for inclusion and an additional 30 items were randomly selected from the Stanford Test. From each of those two groups of 30, 15 random items were picked and combined to make Form A of the test. The other 15 items from each were combined to make Form B. Both forms were arranged in order of difficulty of the items with the Stanford items first.

The achievement test and the interest inventories were administered in late September of 1975 to between 900 and 1,000 students of the teacher participants and their counterparts in the control group. Both measures were administered again in early May of 1976 just prior to the closing of schools for the summer.

Unfortunately, as of this writing, the results of the paper-and-pencil measures have not yet been tabulated. However, there are many other indicators that the project is achieving many of its goals. The interest of the teacher participants was maintained throughout the year with virtually no absenteeism from either the summer workshop sessions or the in-service training during the school year. Of the original 17, one teacher had a schedule conflict she could not resolve and two others had their responsibilities shifted from teaching to non-teaching, but they continued to attend the in-service training. The excellent attendance cannot be accounted for by the university credits being earned, as fewer than half of the participants were actively pursuing an advanced degree.

School resources of the participants were often very limited, but all of the teachers found ways to take their classes on science-related trips. In one case where school buses were unavailable, the teacher arranged a walking trip for her class to a nearby woodland pond to view the pond life. Other teachers took a variety of trips and several discovered unanticipated resources in their own classes. The father of one of the students was an officer at the Naval Air Station and, when the class visited that installation, they were met by a Navy photographer and an official escort. Photographs of the class engaged in a variety of activities were later given to the class which made them into a scrap book.

Teachers also showed initiative in other directions. One borrowed a telescope from a high school student she knew and held a night class for her students and their parents during which they viewed the moon and stars and had a class about nocturnal animals.

Outside speakers were brought to the classes. These ranged from the professional speakers made available by the public utilities (e.g., "Mr. Electric" from the local power and light company) to locally available people in the scientific professions: a pharmacist, a nurse, a technician from the local hospital, a doctor, the high school science teacher, a geologist, etc.

Many of the teachers had ordered materials from the state Live Materials Center and then discovered that they were a focus of attention at the school. One teacher obtained some gerbils, fish, and a snake for her classroom. She told the interviewer that children from many other classes came into her room after school and during the lunch periods to watch her animals. The fact that she had obtained a snake was significant because the first time she had ever handled one was during the summer workshop.

The AIR study director asked each teacher participant about the degree of interest shown by the principal and nearly all responded that theirs had been very supportive. In two or three cases, the principal made funds available to order special science equipment even though the regular budget allocation for such things had been exhausted. In several other cases the principal displayed his or her interest by sitting in on the classes when speakers were arranged or when there was a special class activity of some other sort.

All of the teacher participants interviewed were enthusiastic about the project and, more importantly, about their experiences in class during the school year. Two were quick to say that the in-service portion of the project had been the key for them; that without that support they probably would have been reluctant to try anything, but through it they found that other teachers were having success. Nearly all of them had developed additional ideas to try out during the following school year and all felt that their teaching ability had been materially improved by participation in the project.

Summary Comments

It seems evident that the quality of science instruction experienced by the students of the teacher participants in the Texas A. & I. project was much improved over that which they would have experienced had their teachers not been involved with the program. It cannot be known for several more years whether or not an increased number of those students opt for science careers, but it seems inevitable that they will have a better understanding of and appreciation for science. It is certain that the teachers' outlook toward science was materially changed as was the enthusiasm and methodology with which they taught it. From their own accounts, their experience was so positive it seems highly unlikely that any will ever again teach science in the manner utilized before participation in this project.

It is unfortunate that the entire evaluation thrust of this project was aimed toward the students. When those data are analyzed, they may or may not show significant change, depending on many factors not related to the quality of the programming. Less remote measures of teacher participant activity would have better served this effort.

7. CASE STUDY--STANFORD UNIVERSITY

"Curriculum Variables in Mathematics Learning"

September 1, 1974--August 31, 1975

NOTE: *The Stanford University effort was aimed at furthering knowledge about the mechanisms of learning mathematics and involved no attempt at any intervention strategy for increasing the participation of minorities in science. It was funded by NSF as a study, rather than a project, and would not have been included in this evaluation except for its direct contact with minority students. The work will not be discussed in the same terms as the 10 projects because that would do a major disservice to the technical accomplishments of the effort. Rather, the project work will be described briefly and without critical comment.*

Original Brief Description

Stanford University will test the effect of a single mathematics curriculum variable on student learning. There will be two separate but parallel sequences of experiments. Each experiment in one of the sequences will use as subjects primarily Anglo students. Each experiment in the other sequence will use as subjects Chicano students. The product of this study will be knowledge about the effects of certain variables on the learning of certain parts of mathematics by certain kinds of students.

Steps in the procedure:

1. Curriculum variables will be selected.
2. Programmed units and criteria tests will be developed.
3. A battery of pretests will be selected.
4. Test classes will be selected and pretested.
5. Results subjected to multivariate analyses of covariance, etc.
6. Technical reports prepared.

There does not seem to have been a great deal of work done on cognitive learning on the part of Chicano students. However, what little is known clearly indicates that learning processes for Chicano and Anglo students are quite different.

Project Personnel

Administrative Staff:

Edward G. Begle*	Project Director Professor of Education and Mathematics Education Stanford University
Barbara Pence	Project Coordinator Research Associate Stanford University

Research Staff:

Sau-Lim Tsang	Graduate Student Stanford University
Joan Ginpher	Graduate Student Stanford University
Robert Enenstein	Graduate Student Stanford University
Teri Perl	Graduate Student Stanford University

Cooperating School Personnel:

Samual Rodrigues	Principal Washington Elementary School San Jose
Jesse Rizzo	Mathematics Coordinator Washington Elementary School San Jose
Mr. Casazza	Sixth grade instructor Washington Elementary School San Jose
Ms. Knight	Fifth grade instructor Washington Elementary School San Jose

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*Individuals whose names are underlined have been interviewed.

Ms. Schutz	Fifth grade instructor Washington Elementary School San Jose
Ms. Sotelo	Fifth grade instructor Washington Elementary School San Jose
Ms. Theiss	Fifth grade instructor Washington Elementary School San Jose
Mr. Jones	Mathematics Department Head and eighth grade instructor Burnette Junior High School San Jose
Ms. Lee	Eighth Grade instructor Burnette Junior High School San Jose
Ms. Richards	Eighth grade instructor Burnette Junior High School San Jose
Mr. Taylor	Eighth grade instructor Burnette Junior High School San Jose
Ms. Perazzo	Mathematics Coordinator Hoover Junior High School San Jose
Ms. Chan	Seventh grade mathematics instructor Hoover Junior High School San Jose
Mr. Parks	Seventh grade mathematics instructor Hoover Junior High School San Jose

Participants: At each school, three to 11 classes of approximately 23 students participated in various aspects of the research. The typical involvement of the students was for a two-week period of special programmed instruction in mathematics topics. That contact had taken place five months to a year prior to the AIR site visit and the group of four 6th-grade students from Washington Elementary School and eight 8th-grade students from Hoover Junior High School who were interviewed were not able to add much information, so no further participant interviews were sought.

The Context

The Stanford University effort was a continuation of a years-long program of research carried out by the School Mathematics Study Group at Stanford. Some time ago, Begle had observed that the theoretical understanding of the cognitive processes involved in the learning of mathematics was weak for Anglo students and almost nonexistent for Chicano students. However, what little was known clearly indicated that the learning processes for the two groups were quite different. Because of these differences, experiments involving mixed groups of Anglo and Chicano students would be inefficient, since the results would be confounded.

The first three experiments in the sequence using Anglo students as subjects were carried out by Begle during the 1973 - 1974 academic year. Those led to the identification of three more clusters of curriculum variables for study during the 1974 - 1975 academic year. One of those variables involved the nature and extent of a review at the end of a section or chapter. A second variable was concerned with the type and frequency of tests used in conjunction with particular curriculum materials. (Earlier studies indicated that frequent tests provide greater student learning than infrequent ones but that difficult tests are less beneficial than those of medium difficulty level.) A third variable was that of reading comprehension.

Program Definition and Planning

As previous research results were analyzed and priorities established, graduate students associated with the Stanford Mathematics Education Study Group (SMESG) were assigned to each study to develop the instruments and carry it out under the general direction of the Project Director, Begle, and the Coordinator, Pence. Teaching materials and test instruments were usually selected from among those used previously by the research group in other studies, and then edited so that they would fit the particular group with which they were then working.

Since the research group had been operating for several years, administrative personnel in the school systems in the vicinity of Palo Alto knew Begle and were familiar with the kind of research he had been doing at Stanford. Thus, arranging access to the schools was quite straightforward. In general, Begle or Pence contacted the Superintendent's Office of the School District, was then usually referred to a deputy in charge of research who, in turn, set up a meeting with the concerned school principal. Then, Begle and the staff associated with the particular study visited the school, met with the principal, and briefed the teachers and guidance personnel whose students would be affected.

Programmed materials were used so that there would be no teacher variables. Careful instructions to the teachers were always included and they were admonished not to offer extra help to the students nor to have material-related interactions with them. In most cases, the graduate student carrying out the study was in the classroom to maintain quality control and to provide student contact where that was necessary.

At the conclusion of each study, a report was sent to the principal of the school and to the superintendent of the school system in which the study took place and program feedback was given to any of the teachers who expressed an interest in it.

The nature of the research required that program materials not be related to topics which had been covered in the students' classes. Therefore, care was taken to provide topics which were either supplementary to the normal instruction or which were yet to be covered. Because of the lack of continuity between the day-to-day classwork and the materials presented during the study, it was generally arranged that the study be carried out during a "dead period" just before a holiday or between units of the regular curriculum.

Participants

Individual schools were identified on the basis of the education level (elementary, junior, or senior high school) and the approximate ethnic mix desired by the researchers. Generally, entire classes were used, but in the studies which involved reading ability, all students who were in the English as a Second Language (ESL) Program were eliminated from participating in the research due to possible reading difficulties.

At the three schools, the proportion of Mexican American students ranged from 44% to 83%. Five 5th- and 6th-grade mathematics classes were utilized in November and December, 1974; 11 7th- and 8th-grade mathematics classes were involved in January of 1975, and eight 7th-grade mathematics classes were included in the study conducted in June of 1975.

Program Activities

Four separate studies were conducted during the period covered by the NSF grant. The first two (conducted in November-December of 1974) involved 5th- and 6th-grade Mexican American students. The first of these efforts tested the effect of a review of prerequisite skills and concepts on the learning of a topic in mathematics. The second study at Washington Elementary School involved a special analysis of the results of the first study. It investigated two alternate scoring methods for one of the measures and did not require the further testing of any students.

The third study compared content structure and cognitive structure in Chicano students' learning of mathematical probability topics. It was carried out in January of 1975 with 11 7th- and 8th-grade mathematics classes at Burnette Jr. High School in San Jose.

The fourth study was carried out at Hoover Junior High School in San Jose in June of 1975. It investigated the effect on Mexican-American students of pretraining on parallel test items before the administration of a mathematics predictor test. Eight 7th-grade classes were involved.

For each of these studies the classroom pattern was similar. The first two days were devoted to the administration of pretests and the third was used to give the students practice with the programmed text format. Then, the students spent the next several days working on the instructional material, each proceeding at his or her own rate of speed, and post-measures were taken as they finished their work. The typical involvement of the students was for one hour each day for 10 school days.

Results

The result of this series of efforts was a clearer understanding of several elemental issues related to the effect of cultural background on the ways students have learned to learn. Technical reports linking this work with the earlier work of the Stanford Mathematics Education Study Group and other researchers have been published as SMESG Working Papers and are available from Professor Begle's office.

8. CASE STUDY--MICHIGAN STATE UNIVERSITY

"Evaluation and Comparison of Methods of Increasing Science
Career Awareness"
May 15, 1974--October 31, 1975

Original Brief Description

> Four specific methods of increasing science career awareness among minority junior high school students will be compared and evaluated:
>
> 1. A film of between 15 and 20 minutes in length.
> 2. A slide show in conjunction with the visit of a minority scientist.
> 3. Television commercials aimed at the students' parents.
> 4. Career guidance seminars for junior high school counselors.
>
> Thirty rural and urban junior high schools in Michigan of varying economic and educational achievement levels as indicated by the Michigan Department of Education's Assessment of Michigan Schools (AAMS) will be chosen as test sites. A science career awareness questionnaire administered to the participating students and enrollments in 9th grade science and mathematics courses will measure the level of science career awareness among participants before and after exposure to one of the four test methods. A personnel data questionnaire plus the AAMS information will provide social, economic and educational data about the participants which will be correlated with the responses of the participants to the test methods.

The Michigan State University project was hampered by incomplete planning and an inability fully to convey the objectives and rationale of the program to the cooperating personnel in the various high schools and junior high schools around the state. This, in turn, caused many school coordinators to participate unenthusiastically in the tasks asked of them. Film production delays caused additional problems and the net outcome was scattered data collection and equivocal results.

Project Personnel

Administrative Staff:

Sherwood Haynes*	Project Director Professor of Physics Michigan State University
Carl Baumgardner	Project Coordinator June 1974 through December, 1974
Charles Thornton	Project Coordinator as of January 1st, 1975
Fred Parittee	Carried out presentations of slide and tape show
Ted Berkic	Director of Project-produced film Member of the faculty at Michigan State University Instructional Media Center

School Coordinators:

Jewel B. Green	Chairwoman, Math Department Northern High School Detroit
Bennie Mae Latimer	Science teacher Cooley High School Detroit
R. Gordon Powers	Science teacher Webber Junior High School Saginaw
Fred Richards	Science Coordinator Fennville Regional High School Fennville

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*Individuals whose names are underlined have been interviewed.

Malcolm Stevens	Guidance Counselor Muskegon Heights High School Muskegon Heights

Fourteen other high schools and junior high schools participated in the project and had coordinators. However, many of the original group of schools did not carry out their part in the project and AIR attempts to contact personnel at those schools to arrange interviews were discouraged by MSU project personnel.

Participants: At each of the high schools and junior high schools involved in the project, several science classes were identified as part of the target population. Generally, the size of these classes ranged from 20 to 25 students. Thus, at each of the participating schools there were between 80 and 150 potential student participants. None of these potential participants were interviewed as such contact was discouraged by project personnel and, given the brevity of project inputs and the many months which had passed since those inputs were made, the issue was not pressed.

Associated Non-Project Personnel:

Truman Woodruff	Chairman Department of Physics Michigan State University
Donald Graham	Consultant for film content

The Context

The Physics Department at Michigan State University has long had a commitment to equal opportunity in careers in physics. In 1973, it established an aggressive affirmative action committee, under the chairmanship of Sherwood Haynes, the director of this project, to deal with the problem of the under-representation of women and ethnic minority members in physics. It was the experience of the department that very few minority students elected to take physics courses and the number among those who majored in physics was essentially zero. The other science specialties and the engineering program were having much the same experience and the latter had just developed a slide and tape show to be used in their recruiting visits to the local high schools. Truman Woodruff, the Chairman of the Physics

Department, felt that it was necessary to find ways to stimulate the interest of minority students in the physical sciences. He hired Carl Baumgardner, an ex-student of his, to initiate several affirmative action program ideas that Woodruff had in mind.

Project Milestones

Carl Baumgardner was given a one-year appointment by the Physics Department at Michigan State University for a period beginning in September of 1973.

1973

Fall	Baumgardner and Haynes send proposals to General Electric and Ford Motor Company to get funding for a counselor for the minority students in the science programs at MSU and for a recruiting team to operate in the region's high schools.
November	An NSF brochure announcing the minorities in science programming crosses Woodruff's desk and prompts the decision to try to test tools which would make recruiting more effective.
December	Baumgardner calls NSF for more information, outlines the proposal idea, and is encouraged to submit a pre-proposal.

1974

January	Baumgardner submits pre-proposal to NSF.
February 4	Letter from NSF encourages a formal proposal.
February 20	Formal proposal submitted.
March 15 & 16	The NSF review panel meets to consider all of the proposals received in this funding category. The Michigan State University project is recommended for approval.
April	Having had no word from NSF regarding the status of the proposal, Baumgardner concludes arrangements to attend law school in September when his one-year Physics Department appointment terminates.

1974

May 22	NSF sends letter of award to Dr. Clifton R. Wharton, Jr., President of Michigan State University.
June 1	Project begins.
June	Baumgardner delays his law school enrollment until January of 1975 in order to get the project started and to find and train his replacement.
August	Meetings regarding movie production begin with Media Center personnel.
September	Charles Thornton hired on a half-time basis.
October-December	Baumgardner and Thornton develop student questionnaire instrument.
Late November	Arrangements completed with participating schools.
December 31	Baumgardner leaves project; Thornton becomes full-time coordinator.

1975

January	Continuing problems with film arrangements finally resolved. Script-writing begins.
Late February	Film shooting begins.
Early March	Film shooting ends.
Early March	Pretesting takes place at participating schools.
March 13-14	Counselor conference takes place at Michigan State University Campus.
March-April	TV spot announcements aired.
April-May	Students in Michigan's public schools make selections of following year's courses.
May	Film shown at those schools in the film treatment group.
Late May-Early June	Posttesting of students at participating schools takes place.
Late November	Science enrollment information is acquired from the seventh participating school. Similar information from the other seven schools not obtained.

Critical Steps

Program Definition

A major difficulty faced by this project was a lack of restraint in the planning of the program coupled with an overly optimistic view of the kind of research which can be accomplished outside of a laboratory. The goals were fairly clear, but operational definitions and procedures were never spelled out. As one result of this, project concerns ultimately centered on the film production almost to the exclusion of other efforts despite the fact that the film approach was only one of four being tried out.

Program Planning

While the project was brave in its overall concept, it is apparent from the proposal that the project was not well thought out. There is no time-line of activities, no discussion of how the project representatives at each school would be selected nor what their responsibilities would be, and no mechanism established for the counselors who participated in the seminar series to convey what they had learned to the students in the science classes, some of whom they might advise during the 3-month period between the counselor conference and the posttesting, but many of whom they would not.

There were difficulties, too, with the budgeting of time and personnel resources. The selection of participant schools was carried out on the basis of theoretical considerations such as general economic level, achievement level (as defined by the State Department of Education), and location, but virtually ignored practical considerations such as the amount of traveling necessary to visit them. The result was that the schools were spread very widely across the state of Michigan and personal contact between project and school personnel was minimal. Virtually all communication took place via letter or telephone. Personal contact was made even less possible when difficulties with the film production arose and the project coordinator found it desirable to devote virtually all of his time to that single effort.

Another element apparently missing in the planning of the project was the benefit of knowing the outcomes of previous research utilizing one or another of the planned methods for increasing career awareness. There has been some experience, for example, with special training for counselors. Does that experience show that it is reasonable to expect a positive second order effect on the general student population after a single 2-day seminar for the counselors? What has been the experience with a short, single exposure to a filmed presentation without subsequent follow-up? Questions such as these seem not to have been asked.

An evaluation was planned to assess the effectiveness of the various types of presentation. Questionnaires were to be used to collect information from the student participants regarding their knowledge of science careers, their attitudes toward science careers, and the sources of those attitudes. Measures were to be made both before and following the implementation of science awareness programming. In addition, the enrollment of the experimental participants in science and mathematics courses during the following school year was to be compared with similar information from a control group of schools.

Staff Selection

As already pointed out, the method for selecting the coordinators at various participating schools was not spelled out in the proposal. Interviews with some of these representatives and project management personnel indicate that this selection was left up to the school principals. In many cases, teachers who were solicited to participate were interested in, and enthusiastic about, the project. However, in other cases, the principal assigned the duty to an individual against that person's wishes. The result was a very uneven level of cooperation from school to school.

Participant Selection

Though the proposal does not specify how the student participants were to be selected, the five school coordinators who were interviewed each explained how the selection took place at his or her school. At one school, the participants were all of the students in the 9th-grade science class; in another, the participants were science students in the 10th-grade; in a third school, 100 students who had or were then taking a science class were chosen from among the 9th-grade algebra students; a fourth school used all of the students in the 9th-grade general science classes; and the fifth school utilized biology class students which included all of the 10th-grade and a few 11th- and 12th-graders.

It is clear that control over the student selection process was weak and that the participants must have varied considerably from school to school in the strength of their science background and the strength of their commitment to science courses. The comparability of results was further compromised by the fact that no concerted effort was made to reconvene the original groups for the post-measure administration. The result was a loss of participant population of 25% to 50% in some schools.

Management

The problems of management of this project raise some special issues. Baumgardner, who wrote the original proposal, had had no previous experience with the management of a project of this sort; neither did he have social science evaluative skills. His major contributions to the project were his enthusiasm, his energy, and his vision of what he had set out to accomplish. His successor as coordinator, Charles Thornton, brought counseling skills and a special sensitivity to the dilemmas of minority students, but was similarly lacking in evaluative skills and project management experience. Sherwood Haynes is listed as the Project Director, but the proposal budget shows that he was expecting to devote only 5% of his time to the project and that averages just two hours a week. Discussions with Haynes, Baumgardner, and Thornton confirm that the latter two had full responsibility for running the project on a day-to-day basis while Haynes stepped in to lend his weight to the resolution of specific kinds of problems, such as the negotiation for school participation.

The result was that the project showed fairly consistent forward movement, but that movement was only loosely coordinated; there was no one with a clear view of the whole picture. This was especially true once Baumgardner had left the project, since Thornton had a different mix of skills and was coming from a different background. Naturally, he had his own concept of what the project priorities ought to be.

The shadow leadership of Haynes may have had an additional unanticipated consequence. Haynes co-signed all outgoing correspondence but, except in a few isolated cases, never had direct contact with any of the project representatives at the schools. One of those who had attended the counselor's seminar at the MSU Campus, said that he was very surprised when Haynes did not appear on the program and added that he did not really feel in contact with the project since, as far as he could tell, he was dealing only with a lieutenant and never with the general.

Programming Activities

From the point of view of the participating students, there was one dominant program activity: the pre- and post-questionnaires they were asked to fill out. In addition, of course, groups of the students were the intended audience of one of the four test methods for building science career awareness.

The school coordinators interviewed said that there was some student resistance to the questionnaire and confusion about how to answer many of the questions (e.g., questions about the father's activities when, in fact, the father was not living with the family). It is not known how widespread this problem was and there was no indication that it caused any major problems, but it was clear that adequate pretesting of the instrument had not taken place.

The questionnaire itself is rather rough. It is repetitive and asks numerous questions about science and scientists without either explicitly or implicitly defining what the terms encompass. Thus, some students might respond that they did not know any scientists because none of their acquaintances worked in a laboratory, while other students would know that science has a much broader definition. Many changes in response between the pre- and the post-measure simply could reflect the learning of a definition rather than a newly activated interest in science.

Student exposure to the career awareness inputs varied greatly from one subgroup to the next. Two of the four coordinators who attended the counselor conference were interviewed and both said that they had personally benefited greatly from the two-day experience. However, it is questionable whether the student participants in their schools were impacted at all. One of the counselors worked in a 90% Black school where he had a counseling load of about 300 students. The conference at MSU took place in the middle of March and the posttesting of the students took place in late May and early June. The counselor said that during the interim he was not asked by MSU, nor did he volunteer, to carry out any special counseling of the participating students. His counseling load includes only those students whose last names begin with Q to Z, so even had his normal duties brought him into contact with all of his counselees who were participating in the program, only a third of the total group could have been affected. The other conference participant works at a school which is nearly all White (the most recent graduating class of 110 included one Black and eight Mexican Americans) and is the science coordinator, so had daily contact with the student participants in the project. He said that he had not done anything differently in his classes or in his contact with his students as a result of the experience at Michigan State University and, though he had become much more aware of the difficulties of minority students, he did not feel that the information was particularly relevant for him as the minority students he came in contact with seemed to him to be very able.

The television spot advertisements, which were produced without a great deal of difficulty, were not directed primarily at the students and there was no mechanism for determining whether or not the students viewed any of them. One school coordinator said that a check at the time of the posttests revealed only a handful of the students in his four science classes who remembered having seen the ads.

The movie production was completed in March of 1975 and it began to be shown in the schools soon after that. One of the coordinators interviewed was at a school which had been assigned to the film condition. Though the original intent had been to have a minority scientist present the film and conduct a question-and-answer period following the 15-minute showing, such was not the case at this school. The coordinator said that she showed the film and then attempted to establish a connection between the film and science careers during the question period which followed. She said that it would have been more effective had someone in the science field presented the film. No further project-related activities were scheduled between the time the film was shown and the posttest, so maximum project contact was quite brief.

The slide and tape presentation was made by Fred Parittee, a Black chemist. The slides, and the taped commentary which went with them, were designed to make the same points as did the movie and the television spot announcements. A coordinator whose classes participated in this experimental treatment said that the students seemed very interested in the presentation and were able to relate to the speaker. There was a discussion period following the presentation during which the students asked rather involved, in-depth questions. The coordinator said that she was very pleased with the speaker and felt that he had handled the assignment very well. The total time devoted to the presentation was one hour.

Program Evaluation

The planned evaluation of the impact of the various methods for increasing science career awareness included the scoring of the pre- and post-questionnaires administered to the four experimental groups and the control group in a way which would indicate the student's level of science career awareness. The pre-post difference scores were to be summed across participants within each subgroup to yield an "effectiveness factor" for the test method to which that group was exposed. It was planned, also, to derive an effectiveness factor for each test method from the enrollments in the science and mathematics courses in the term following the students' project involvement. The cost of each test method was to be divided by the sum of the two effectiveness factors to yield a cost/benefit ratio which would then be compared with a ratio derived from the control group (though it is hard to understand how the latter was to be accomplished since there were no "costs" associated with the control condition). Internal comparisons based on economic level, school achievement level, rural-urban location, and other factors were also planned.

Lack of interest at the schools resulted in complete data from only seven of them and no evaluation report. But there was little likelihood that the evaluation could ever have been successfully carried out, even had the project gone exactly as planned. The scoring of questionnaires according to "what we think the response shows" (as stated in the proposal) without an item analysis or attempts to establish the validity of the instrument would certainly have resulted in massive amounts of random variance which would mask whatever relationship there might have been between the questionnaire responses and science career awareness. There was no suggestion that just minority students' measures were to be utilized, yet the participating schools varied in minority enrollment and the three types of visual input depicted only Blacks. Further, it would have been totally inappropriate to ascribe improvements in science and mathematics enrollment to project inputs when numerous other factors, such as the ability or popularity of the science teacher, also affect that enrollment. Finally, any value arrived at as a cost/benefit ratio for a test method would be spurious unless the method had been presented at its most effective strength. For example, a 15-minute movie shown once could be expected to be less effective than the same movie shown twice (with no additional costs associated with the second showing).

Summary Comments

While this project had many problems of supervision and control, the proposal review panel of NSF is a full partner in the project's fortunes since many of the weaknesses experienced were fully evident in the proposal. While NSF's decision to fund a project does not imply approval of all project elements, it does create for the project a general aura of "quality" which deters further self-examination by the proposer. By its acceptance of a totally inadequate and inappropriate evaluation plan, NSF virtually assured the project's failure.

9. CASE STUDY--UNIVERSITY OF CALIFORNIA, LOS ANGELES

"Increasing the Flow of Ethnic Minorities into Careers in Science"

July 1, 1974--June 30, 1977

Original Brief Description

> The University of California, Los Angeles seeks to encourage and promote interaction between its math and science staff, and students and staff in two high schools (a low-achieving high school and a high-achieving high school). The project personnel will assume total responsibility for the math and science instruction of the student participants. Forty students from each high school will participate in the project for three years corresponding to the students' tenth, eleventh and twelfth grades. Three days a week the students will receive instruction at their home schools, and two days a week they will engage in common activities either at the University of California or in industry. Two teachers (one math and one science) will provide the basic instruction in the math-science seminar supported by teaching assistants from the university. Teachers will participate in summer and academic year pre-service and in-service workshops. During their senior year, participants will take university courses in math and science. Participants will be compared with matched control groups to determine the cognitive and affective effects of the project over the three-year period.

Despite some first-year difficulties with the teaching assistants, the project has been able to carry out two major structural changes in the way science/mathematics classes are taught in the two cooperating high schools. The class size has been reduced from about 35 to 20, and a university graduate student has been employed part-time as a teacher's assistant in each of the classes. This has allowed considerably improved instructor-student contact. Monthly Saturday workshops put the teachers from the two participating high schools in contact with each other and with the University of California science staff.

Project Personnel

Administrative Staff:

Winston Doby*	Project Director Assistant to the Chancellor Office of Academic Programs University of California, Los Angeles
Merton Burkhard	Project Co-Director Physics lecturer at UCLA and a high school physics instructor
Vicki Nock	Acting Project Director, July 1974 to date Coordinator of Special Projects Office of Academic Programs, UCLA
Jane Wilzbach	Project Coordinator, July 1974 - June 1975 Graduate student in physics at UCLA and a high school teacher
Thomas Inman	Project Coordinator, July 1975 to date Former project teaching assistant, 1974 - 1975 Graduate student in physics at UCLA and a high school teacher

Teaching Assistants:

Leticia Valenzuela	Graduate student in biology at UCLA
William Rosen	Graduate student in mathematics at UCLA

Participating High School Personnel:

Eugene McAdoo	Principal Washington High School
Eardley Madsen	Chemistry teacher Washington High School
Connie Hamilton	Math teacher Washington High School
Luther Sherman	Biology teacher Washington High School

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*Individuals whose names are underlined have been interviewed.

Irbine McConagy	Principal Westchester High School
Connie Rupert	Vice Principal Westchester High School
Susan Cohen	Mathematics teacher Westchester High School
Jan Simison	Biology/chemistry teacher Westchester High School

Associated Non-Project Personnel:

Joseph Cascarano	Professor of Biology UCLA
Carl Sewell	Director Joint Center for Community Studies (which is providing evaluation support for the project)

The Context

The University of California at Los Angeles has had a long-term involvement with Los Angeles County High Schools. The university provides a variety of services to the area schools and has also carried out several cooperative projects with them in the past. As Assistant to the Chancellor for the Office of Academic Programs, Winston Doby has responsibility for several special programs related to the stimulation of minority students at the University. In 1973, recognizing that minority public schools faced a wide variety of problems, he began thinking about an attempt to deal with an elementary/junior high/high school cluster which was on a downtrend and work with it massively to try to turn it around. It soon became apparent to him that this was just too complex a problem, so he decided to try to impact the high school level with a demonstration of what could be done when the resources of a university were brought to bear.

Project Milestones

1973

Fall	Doby submits a proposal to the National Institutes for Education for a very large-scale project to renew an inner-city school by bringing it outside resources from the university.
November	NIE responds positively, but says that the scope of the project is really too large for them to consider.
November	Doby visits NSF and outlines his idea to them. NSF advises him how large a project they could consider supporting and encourages him to submit a prospectus.
Early December	Doby submits a prospectus and is subsequently encouraged to submit a full proposal.

1974

January 21	Full proposal is submitted to NSF.
March 15 - 16	The NSF review panel meets to consider the proposals received in this funding category. The UCLA Project is recommended for funding.
Mid-May	Doby, who has been in contact with NSF frequently, receives a verbal "99% sure" assurance from NSF that the project will be funded.
Mid-May	Selection of student participants begins.
May 22	NSF sends letter of award to Charles E. Young, Chancellor, University of California.
June 1	Wilzbach hired as Project Coordinator.
Early June	News of the project award is received through official channels.
June 6	Doby sends a letter to the participating schools notifying them of the NSF grant award.
Mid-June	Discussions are held with high school personnel regarding their project roles. Selection of participating teachers takes place.

1974

July 1	Teaching assistants hired.
July	Four-week summer planning session with the participating high school teachers and teaching assistants takes place at UCLA.
Early September	Meetings for student participants' parents held at both high schools to explain the project.

1974-1975

September to June	Monthly Saturday sessions dealing with both logistical and teaching problems take place during this period with the participating teachers, teaching assistants, and UCLA project staff.
July	Three-week summer planning session takes place with participating high school teachers, teaching assistants, and UCLA project staff.

1975-1976

September to March	Monthly Saturday workshops continue during second year of project operation.
September to June	Supplementing regular project programming, 24 career-oriented field trips (2 to 5 per student) are taken to various sites in the Los Angeles area. Also, each school is visited by five or six outside speakers who talk about career opportunities in science.

Summary Comments

The UCLA project has just completed its second year of activity and has one year to go. The experience thus far is one of qualified success; much new programming has been introduced to the science and math classes, but there have been some problems maintaining teacher enthusiasm. The project, which had been operating with part-time direction, has now moved to full-time direction and hopes to alleviate the series of minor difficulties it has been having.

10. CASE STUDY--COLORADO STATE UNIVERSITY

"Incentive Program in Science and Engineering"

May 15, 1974--June 30, 1977

Original Brief Description

> The Incentive Program in Science and Engineering (IPSE) is aimed at testing mechanisms for increasing the flow of minority students into the sciences and technologies. The program, based at Colorado State University, will work with 150 students in 15 high schools in the state of Colorado which have high enrollments of Black and Chicano students. IPSE will make first contact with the students in their sophomore high school year and remain in contact until their senior year. IPSE will attempt to interest the students in careers in the sciences by stimulating enrollment in existing courses in science and mathematics, providing and supervising a junior year science project, providing contact for the students with local high school facilities, and helping students choose and apply for college admission. At crucial junctures in the program, participants will be tested to get a firm idea of how they perceive themselves in relation to job roles and careers, and to monitor how those perceptions translate into concrete preparations to pursue a career in science. Each component of the program will be monitored as to how effective it has been in contributing to the overall goal and at what cost and effort.

This project is attempting the development of mechanisms for stimulating the entrance of averagely qualified minority students (it specifically excludes those with an already well-developed interest in science) into scientific careers. It includes four components which it deems to be crucial:

1. The early (i.e., well before college entry) development of an interest in science, both as a subject to be studied formally in school and as an absorbing intellectual experience.

2. Early rewarding experiences obtained from formal and informal associations with the people, tasks, and milieu in science.

3. A developing identification of "self" with the perceived role of the scientist or engineer.

4. The early translation of a developing interest and self-identification with science into at least a tentative commitment to study scientific and technical subjects in high school.

The project's plan is to establish contact with students in their sophomore year and to follow them through their senior year while encouraging them to utilize the high school's teaching and counseling resources and providing them with supplementary counseling and tutorial services.

Project Personnel

Administrative Staff:

Ernest Urvater*	Project Director Assistant Professor of Physics Colorado State University
Carolyn Urvater	Project Coordinator
Richard Shikiar	Project Research Director Assistant Professor of Psychology Colorado State University

Contact Personnel at Participating High Schools:

Donald Moser	Assistant Principal Thomas Jefferson High School Denver
Beverly Hall	Head. Counseling Department Adams City High School Commerce City

Thirteen additional contact personnel have not yet been interviewed.

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*Individuals whose names are underlined have been interviewed.

Participants: None of the 130 participants have yet been interviewed as the program is still ongoing. Plans have been made to interview a sample of the participants in the late spring of 1977 just prior to the end of their involvement with the IPSE Program.

Associated Non-Project Personnel:

Richard Flemming	Coordinator for the group that developed the science modules
Donald Cervone	Psychology Graduate Assistant to Dr. Shikiar

The Context

At Colorado State University, individual concern and University commitment joined to provide the context for this study. The personal interest of Ernest Urvater stemmed from his experience in New York State, first as a post-doctoral fellow at the City University of New York during a time of extreme controversy regarding minority education, and then as a staff member at one of the State University Colleges. At the latter, he became involved in a program which accepted special students, including many minorities, with various physical and learning disabilities or police records and gave them a pre-college year in a health and social services program with the idea that this bridge year would help them to adjust to a regular college curriculum. Urvater directed the math and science component of the program. Since many of the bridge students continued at that college, Urvater was able to maintain contact with them and found that their retention rate was even better than the rate for the general college population; a relatively small effort had produced great benefits.

Later, when Urvater began teaching at Colorado State University, he participated in the tutoring programs that had been set up for minority students, but began to feel that it was hopeless to try to interest minorities in science careers as late as college. He found that there was often a severe mathematics deficiency and could not see how a mere summer program could remedy that, so he began thinking in terms of a long-term approach.

Colorado State University has a commitment to minority students which is principally expressed in a program begun in 1968 called Project GO (Generating Opportunities). GO utilizes a staff of student and faculty advisors to assist minority students who have a need for counseling, academic advising, tutoring, or financial aid.

Project Milestones

Urvater's thinking about a science program which would utilize existing school facilities started to become more concrete when he saw a National Science Foundation Experimental Projects Division brochure announcing the Minorities in Science program in the fall of 1973. Following are the critical milestones in the history of the project to date.

1973

Fall	Urvater calls the National Science Foundation and outlines his idea for a project. He is encouraged to pursue his idea and is left with the impression that a 3-year program is the maximum that NSF would fund.
Fall	Urvater submits a pre-proposal to NSF and receives a telephone response within about 10 days suggesting that a systematic evaluation would be required if the project was to be considered as a research proposal.
December or January 1974	Second preliminary proposal submitted to NSF.

1974

February 11	NSF responds and encourages a full proposal.
Mid-February	An on-campus evaluation specialist is sought to assist in the preparation of a full proposal.
February 27	Full proposal is sent to NSF.
March 15-16	Review panel meets to consider all of the proposals NSF has received in this funding category. The Colorado State University Project is recommended for approval.

1974

Spring	Urvater contacts three high schools and finds considerable enthusiasm for possible project participation.
May 22	NSF sends letter of award to Dr. A. Ray Chamberlain, President of Colorado State University.
Late May/Early June	Contacts initiated with a number of high schools.
Early September	Final arrangements made through school boards and individual school systems for the participation of 15 high schools in the Denver area, Boulder, and Pueblo.
Late September	Student recruitment begins.

1975

January	Student recruitment completed.
February	Program begins and pretesting takes place.
April 26	Ninety-three IPSE participants take field trip to Colorado State University.
May 20	Workshop for all IPSE students and their parents in the Pueblo area.
November	Parents' workshops held for IPSE participants in Boulder, Denver, and other locations.

Summary Comments

The University of Colorado program is attempting to utilize a technique of continuous contact with high school students which emphasizes the use of the high school's resources to the fullest extent possible and which supplements those resources in the area of counseling and career guidance. The premise is that minority students, because of their frequently poor preparation and their lack of role models and other motivating factors, need to have somewhat more encouragement and closer guidance than non-minority students. The IPSE program has made a substantial start in that direction with an initial group of about 150 participants. Progress is being monitored closely and a pattern of relationships has been established or strengthened among students, their counselors, teachers, and parents. The project has offered the students nothing beyond a great deal of assistance in reaching their own goals, plus a feeling of being "special" in a positive sense. Yet the students seem to be responding by electing, and working hard at, science and mathematics courses. The project has one more year to run.

11. CASE STUDY--TEMPLE UNIVERSITY

"An Experimental Engineering Technology Career
Program for Disadvantaged Minority Students"
July 1, 1974--December 31, 1976

Original Brief Description

Temple University will conduct an experimental career program for disadvantaged students at the pre-college level. The project will be divided into three phases covering a period of three years for each participating group. Minority students who have completed ninth grade will be eligible to participate.

Phase I--Career Workshop: Fifteen students will be recruited from Philadelphia inner-city schools. They will attend sessions at the College of Engineering Technology four days a week for six weeks during the summer.

Phase II--High School Participation: Professional counselors will work with the students. Science department heads will work with the students and tutor them.

Phase III--Industry Cooperation: Local industry will provide jobs during Phase III for each participating group.

Three groups of 30 will be considered. These groups will be screened and tested, and 15 will be selected to participate in each experimental group; the other 15 will constitute a control group.

Upon graduation from high school, these students will be eligible to enroll in the College of Engineering in the Special Technology Education Program.

This will be a joint effort of the College of Engineering Technology, the Philadelphia School District, and several industrial firms (GE, Bell, IBM) with some funding coming from industry.

This project has attempted to take a highly selected group of pre-tenth-grade students from minority high schools in the immediate vicinity of Temple University in Philadelphia and to stimulate their interest in engineering by exposing them to a summer program during which they have the opportunity to learn a great deal about what various types of engineers do. During the following (sophomore) school year, the student group reassembled at Temple University on a bi-monthly basis to maintain the project momentum. Individual students were also provided with counseling and tutorial assistance for their regular schooling when that was needed. The second summer of the project is underway and the student participants have been placed in engineering-related summer jobs so that they can have a first-hand understanding of the day-to-day activities of engineers. Also, during the present summer, an additional group of tenth-grade students began a second cycle of the program by attending engineering classes at Temple University.

Project Personnel

Administrative Staff:

Theodore Vassallo*	Project Director Associate Professor of Engineering and Director of Student Services College of Engineering Technology Temple University
Duane Sackett	Outside Evaluator Assistant Dean College of Education Temple University
John Rumpf	Advisor Dean, College of Engineering Technology Temple University

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*Individuals whose names are underlined have been interviewed.

Instructional Staff:

John Tarka	Associate Professor and Department Chairman Electrical and Biomedical Engineering Technology College of Engineering Technology Temple University
Theodore Green	Professor of Civil Engineering College of Engineering Technology Temple University
Alvin Greenspan	Professor of Mechanical Engineering College of Engineering Technology Temple University
T. G. Mackey	Professor of Civil Engineering College of Engineering Technology Temple University
H. P. Higgens	Professor of Electrical Engineering College of Engineering Technology Temple University
R. J. Stone	Professor of Civil Engineering College of Engineering Technology Temple University
Leroy Green	Instructor of Electrical Engineering College of Engineering Technology Temple University

Associated Non-Project Personnel:

William Chapman	Director, Funded Research Office of Research and Program Development Temple University

Participants: No participants were interviewed at this time as the project is ongoing. A number of participants will be interviewed at the time of project completion in December of 1976.

The Context

Over the past few years, Temple University has had several minority programs funded by both NSF and other sources. One of those, the Special Technology Education Program (STEP) was originated by Theodore Vassallo six years ago and has been directed by him since then. STEP was based on the observation that minority enrollment at Temple University in general, and in the engineering disciplines in particular, has not been very high despite the fact that Temple University is located in the center of a heavily minority residential part of the city of Philadelphia. STEP provides tutoring and counseling services to those students who enroll in a pre-engineering program at the College of Engineering Technology. The objective is for those students to be able to get the support they need to be successful in the two-year program of study and then to go on to transfer to a regular four-year engineering program. But relatively few students applied to STEP each year, so Vassallo and Rumpf, the Dean of the College of Engineering Technology, came to the conclusion that something needed to be done during high school to stimulate minority students' interest in, and preparation for, the study of engineering.

Project Milestones

1974

January	Vassallo is contacted by William Chapman of the Temple University Office of Research and Program Development and asked to participate in the writing of a proposal in response to NSF's program announcement in the minority area.
January	Vassallo makes preliminary contact with the Philadelphia School System to see if there is an interest in participating with Temple University in an engineering program.
Late January	Vassallo submits a pre-proposal to NSF.
Early February	NSF encourages a full proposal.
February 20	Full proposal submitted.

1974

March 15-16	NSF review panel meets to consider all proposals in this funding category. The Temple University project is recommended for funding.
Mid-April	On the basis of an earlier phone conversation with NSF, Vassallo expects to have had a decision by this time.
May 1	Since much preparation is needed for the summer program, Vassallo and Rumpf had decided to postpone a potential project start until the summer of 1975 if no news is received from NSF by this date.
May 22	NSF sends a letter of award to Dr. Marvin Wachman, President, Temple University.
Early June	Notice of NSF award is received by Vassallo.
Mid-June	Rumpf and Vassallo make request to NSF to extend the grant period for one year to allow a summer 1975 project start.
July 26	NSF formally extends the grant period to December 31, 1976.

1974-1975

August to March	Pre-planning of instructional approach takes place and information brochures for potential project participants designed.
October	Meetings are held with potential participating high schools and their junior high feeder schools.
March-April	Specific lesson plans are formulated.
Spring	Student participants are selected.
Summer	Student participants attend the six-week summer program.
Summer	Semi-monthly project staff meetings held to discuss student and operational problems as they arise.

1975-1976

Fall to Spring	Project staff counsels student participants as they progress through their normal high school course work and select courses for the following school year.

1975-1976

Fall to Spring	Participants attend bi-monthly Saturday sessions at Temple University.
Summer	Original student participants placed in engineering-related summer jobs arranged by the project and a new group of participants attends the six-week summer program.

Summary Comments

A special effort has been made to keep the program activities at a level which matches the abilities of the participants who, by all reports, have responded with a high level of interest and enthusiasm. Attendance during both the summer and school-year phases has been near perfect. There is some concern regarding the second summer (1976) job placements because the youth of the participants prevents many of them from being allowed to be present on construction sites or where machinery is being operated.

12. CASE STUDY--LOS ANGELES COUNTY SUPERINTENDENT OF SCHOOLS

"Minorities and Science Careers: Counselor Training and Career Guidance Films"

May 15, 1974--September 30, 1975

Original Brief Description

The purpose of the proposed project is to encourage minority girls and boys to prepare for careers in science. The approach suggested is to develop a training program for school counselors directed toward changing discriminatory counseling practices which depress motivational levels of minority students.

An experimental group of 36 high school counselors from schools with sizable minority populations will attend a series of five workshops. The counselors will examine the factors which lead to unequal educational and employment opportunities for minorities and will learn counseling strategies which will enhance their skills in interaction with minority students and their parents. The thrust of each workshop will be presented in a training film. These five films and supplementary materials will be assembled into a counseling in-service training kit which others may use to replicate the training program. The project will also develop five career guidance films about clusters of science careers and featuring minority scientists, both men and women. Following each workshop, the counselors will field-test one guidance film with their experimental groups of minority counselees and practice the counseling techniques taught in the workshops in individual and group sessions. Data will be collected to assess whether the project activities result in a greater number of minority students enrolling in elective science classes and expressing increased interest in science on a standardized vocational interest inventory than a control group not receiving the treatment. The control and experimental students will also be compared on a test of knowledge of science careers.

This project produced 10 short films which are potentially useful in a variety of circumstances. Unfortunately, delays and difficulties with the film production combined with other problems to prevent the project from achieving many of its objectives and from carrying out its evaluation.

Project Personnel

Administrative Staff:

John Landrum*	Project Director Director of the Division of Compensatory and Intergroup Programs
Golden Harris	Project Manager High School Counselor Los Angeles Unified School District
Mary Martin	Consultant Division of Compensatory and Intergroup Programs
Philip Essman	Division of Educational Media
Earl Owens	Division of Research and Pupil Personnel Services
Jean Wiener	Division of Research and Pupil Personnel Services

Counselor Participants:

Homer Altenes	Montebello High School
Roy Benstead	Lawndale High School
Frank Bon	Montebello High School

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*Individuals whose names are underlined have been interviewed.

Maurice Lackey	Morningside High School
Matty E. Lewis	Los Angeles County High School (member of the advisory group)
Aileen Pymm	Lynwood High School
Jan Wieberg	Lenox High School

Twenty other counselor participants were not interviewed.

Student Participants: Theoretically, there were hundreds of student participants, but none were interviewed since maximum student contact with the project had been limited to a single hour of film viewing more than six months prior to the AIR site visit. Many other kinds of films are shown routinely, and it was the judgement of the study director that it was very unlikely that student responses could shed much light on the conduct of this project.

The Context

The office of the Los Angeles County Superintendent of Schools provides leadership and coordination for the improvement of educational programs in all 95 county school districts. The office acts as an extension of the State Department of Education for the dissemination and collection of data, the equalizer of educational opportunities for children, the initiator of new educational programs, and a provider of in-service education to and for the districts of the county, among many other functions. In particular, the Division of Compensatory and Intergroup Programs develops and administers a variety of projects for the benefit of poor and culturally different children and adults. It also provides school districts with consultant services in all aspects of compensatory and intergroup education including crisis intervention. Over the past several years, the division has developed a number of special programs with both internal and outside funding.

When the program announcement from the National Science Foundation arrived, several of the people in the Division of Compensatory and Intergroup Programs met to discuss possible ways of responding to it. Present at the meeting were several people from the division including Dr. Mary Martin, consultant to the division, and Doris Ratcliffe, who was the director of Intergroup Relations for the county. It was agreed at that time that there was special need for some upgrading of counselor training and, since the media department had just completed some successful films for other projects; it was decided to utilize short movies as a training device.

Project Milestones

1973	
December	Martin, Essman and others meet to discuss possible responses to NSF's Minorities in Science program announcement.
1974	
January	Prospectus is written by Martin and sent to NSF.
February 5	NSF responds with a request for a formal proposal.
February 27	Martin submits formal proposal.
March 15-16	The NSF review panel meets to consider all of the proposals NSF has received in this funding category. This project was recommended for funding.
May 24	Letter of award sent to Dr. Richard M. Clowes, Superintendent at the Office of the Los Angeles County Superintendent of Schools.
Early June	The process of advertising for Project Manager is begun. More than 100 people apply.
Early July	Golden Harris is selected as Project Manager; applies for a leave of absence from the Los Angeles Unified School District where she is a counselor.
Late Summer	Essman (media consultant) is incapacitated and lost to the project for August and September. He then returns to work, but only on a part-time basis for another period of time.
August 19	Golden Harris is hired as Project Manager.
Early September	The Advisory Board is established and promotional work for the project is begun.

1974

Mid-September	The decision is made to produce the films through a subcontractor.
September	Recruiting of counselor participants takes place.
Late September	First meeting of the Advisory Board.
October 7	First in-service workshop. The process of identifying the critical counseling issues is begun.
Early November	Second in-service workshop. The selection of student participants takes place.
November	Pretests are administered to seventh grade classes.
Late November	Drafting of scripts for counselor films is completed.
Early December	Ben Norman Productions selected as subcontractor for the film material.
Mid-December	Role models identified and audio taping completed.
Late December	Original target date for completion of counseling films.

1975

Mid-February	Videotaping of the counseling situations completed.
Early March	First sections of edited films completed.
Late March - Late May	Film sections delivered to the project as they are completed.
Late May	Full set of 10 films available.
Late May - Early June	Role model films shown to students in selected high schools.
Late May - Early June	Posttesting carried out.
Early June	Final (eighth) workshop conducted.
October	Questionnaires mailed to counselors who had participated in the project.

Critical Steps

Program Definition

The projected program was a logical extension of earlier work which had been done by the Superintendent's Office, and the original planners of this program obviously had a clear idea of what had to be done in order to accomplish their purpose. An inadvertant discontinuity occurred, however, with the hiring of Golden Harris as Project Manager. Ms. Harris had excellent qualifications for the task in most respects, but her orientation was operational rather than experimental, and those who could have provided the research point of view retreated from direct project involvement. Thus, priorities were implicitly reordered and the research aspect became somewhat less distinct at an early point in the proceedings.

There is a further confusion present in the project objectives: It is not made clear whether the project participants are the counselors or the students they counsel. Project input was directed to the counselors through the planned monthly in-service training sessions. Each counselor was then to interact with 24 students in ways consistent with the training received. Of the six stated objectives, three relate to changes in counselors' behavior or outlook and the others refer to possible changes in students' behavior, though their contact with the project was expected to be only nominal. It should have been feasible to plan a more direct evaluation of the success of the transmission of program content to the counselors and, had this been done, it would have given the project a better focus.

Program Planning

The original planning for this project was well elaborated. Objectives were clearly stated and operationally defined. The proposal included an articulated time-line which should have provided the structure necessary to carry out the project effectively. Both in-service counselor training and training film production were processes familiar to the project planners and that familiarity was clearly evident in the proposal.

The actual budgeting of resources over the period of the project is another story. Two events occurred which seriously affected the time sequencing of the project: NSF funding was later than expected, so by the time the hiring process for the project manager was completed, the project was seven weeks beyond its projected starting date; and the timing was further delayed by the illness of the Los Angeles County Media consultant and the consequent need to go through the process of subcontracting the film production effort. Despite these two setbacks, there is no indication that there was any replanning of how best to reach project goals given the changed circumstances. In fact, just the opposite took place. The process became detached from the original objectives and was more greatly elaborated. The number of planned in-service training sessions was increased from five to 10 (ultimately, eight were held) and the filmed material which had been intended to be produced for the in-service counselors was instead formulated by them, thus further postponing the date when the newly-learned counseling techniques and films would be available for field-testing with their ultimate intended audience, the students.

There were no serious problems with the budgeting of project money, time, and personnel resources, though overall effectiveness could have been improved in two areas. First, the Office of the Los Angeles County Superintendent of Schools could have provided somewhat better technical support to the project director in those areas where her own considerable background was weak: impact evaluation and film production. Though specialists in these areas were available for consultation, the interview data suggests that County staff and the temporarily employed project manager never formed a cohesive working unit.

Second, some accommodation to the time delays caused by Essman's incapacitation could have been made. His illness, the severity of which was immediately apparent, occurred at the very beginning of the project and, had a decision been made then to reduce the total running time of the films or their number, much lost time might have been made up.

Participant Selection

COUNSELOR PARTICIPANTS: The selection of the counselors was a complex procedure which was carried out very well. First, school districts which included high schools with 25% or more ethnic minority population were identified. Contact was made with the school superintendents, administration personnel, and compensatory education directors in those districts and the intent and scope of the program was explained by the project manager in a series of meetings. Those were followed by a formal announcement letter to the superintendents of the school districts who, in turn, suggested specific schools which fit the requirements set by the project manager. Then, the project manager contacted the school principals by telephone to explain the program in more detail and followed that up by sending blank letters of "intent to participate" which the principals used to nominate one or two counselors from each school as participants in the program.

The original plan was for a total group of 36 counselors to participate in the in-service training and an additional 36 from the same high schools to serve as a control group and not to receive training.

Since some dropout was expected, a total of 43 counselors were selected for participation. The project manager visited each of these people before training began to make sure they knew what was expected of them. Although arrangements had been made for all of the counselors to be relieved of school responsibilities so that they could attend the half-day sessions, many felt that too much time was being lost from their work and only 26 of the original group actually completed all aspects of the training program. Of those, 15 were men and 11 women; 14 represented minority groups; and in age, they ranged from 26 to 55.

In terms of the project's key objectives, it was necessary to select a group of counselors for participation who were typical of the population of counselors in the Los Angeles area. Selection was likely to be adequate as long as the principal's counselor nominations were based on some judgement regarding the individual's ability to utilize the training and the participants, themselves, were well-motivated.

The incentives for the participants are clear: an opportunity to improve job-related skills and the pleasant notoriety of participating in a well-publicized, socially relevant special program. For a few of the participants, that was not enough and they lost interest, but for the majority of the counselors, the contact with the project was apparently a positive experience. Nearly all replied to a project-initiated questionnaire that their perception of minority students' special problems had improved and that they received information about minorities that they did not already have prior to the project.

STUDENT PARTICIPANTS: For the student participants, it was desired to find science-eligible tenth graders, yet it was equally important not to include those youngsters who had already committed themselves to a science interest. At the second counselor training session, Dr. Jean Wiener, an evaluation and research consultant at the Los Angeles County Schools Superintendent's Office, explained the student selection process in considerable detail and emphasized the need for random assignment of students to experimental and control groups. Judging by information gathered during interviews with the counselor participants, student selection was carried out with moderate effectiveness. Most schools did set up random groups balanced for minority group and sex, but a few schools introduced bias of various sorts by selecting students from science classes which included both tenth- and eleventh-grade students, or by hand-selecting the experimental students while controls were drawn from the remainder. These latter problems were minor, however, and the mix of student participants in the experimental and control groups was not likely to have caused any difficulty in the interpretation of the impact assessment results.

Programming Activities

The activities carried out were considerably divergent from those which had originally been planned. The late start and the need to subcontract the movie production had a great impact, but a lack of overall program control on the part of the Office of Superintendent of Schools coupled with a lack of understanding of the importance of program evaluation on the part of the project manager also contributed to the problems.

The proposed plan was for the development of the content outlines, training films, and the career guidance films to be accomplished by the project manager, reviewed by the advisory body, and produced in time for the initial training workshop, originally due to take place in November. At each counselor workshop, one new training film was to be tried out with the counselors, strategies developed for dealing with the issues presented in the film, and then one career guidance film was to be shown in the schools while the counseling strategies learned in the workshop were put into practice with the student participants. Due to the unusual delays already cited, the decision was made to go ahead with the training workshops without having the films on hand. Originally the films were expected to be completed by late December, but, in fact, it was only in the early part of December that a film production organization was finally selected. Even with that occurring, there was apparently no attempt either to reduce the task of producing the films by reducing their number or total length or to concentrate on the production of the role model films so that counseling techniques learned in other ways could be coupled with them in a timely tryout of their impact.

In fact, the chief problem confronting this project was an almost total lack of accommodation to the realities of the severe time-bind the project found itself in. Naturally, once the training sessions for the counselors had begun, the project manager was anxious to continue them in a way which would provide a positive experience for the participants. Unfortunately, that process ignored the basic experimental purpose of the project. Other possible options did exist:

- the use of video tape rather than 16mm sound film as a faster, less expensive (though admittedly less "finished") way to a product
- concentration on the production and tryout of the five role model films, or some portion of them, rather than the five training films as we
- presentation of the counseling situations in the form of role-playing so that discussion and learning could take place in the absence of the actual finished films

- the development of a story board format for the role model films for presentation to small groups of students in the absence of the finished film
- the testing of whatever techniques *had* been presented during the counselor training sessions in the absence of the specific training aids

Though the above-mentioned difficulties dominate this project, a great deal of positive programming was accomplished. Guest speakers at the training sessions included representatives from the Anti-Defamation League of B'nai B'rith, the National Urban League, the UCLA American Indian Study Center, the Asian Studies Director of the Office of Urban Affairs for the Los Angeles County Superintendent of Schools Office,and the Director of Equal Opportunities Planning for California State University in Los Angeles. Following the presentations by each of these people, and after the several films which were shown during other sessions, ample time was allowed for group discussion.

Interviews with the counselors and responses by the counselors to a brief questionnaire administered by the County Superintendent's Office confirm that many of those participating found the in-service training highly motivating. Several agreed that the project provided them with a great deal of information which led to new insights into their students' values.

Program Evaluation

Planned Evaluation

The evaluation design outlined in the project proposal called for 36 counselors to participate in the in-service training and an additional 36 to serve as a control group not participating in the training. Each of the 72 counselors was expected to work with 24 students. Twelve of the students of each counselor were to be exposed to the role-model films and 12 were not. All 1,728 students involved were to have previously indicated an interest in science.

Six project objectives were operationally defined and, though never actually spelled out, at least six evaluation measures apparently were planned:

1. The strength of shift in attitude toward science was to be measured both before and after individual and group counseling sessions and the viewing of the role-model films. The Kuder or Strong interest inventory or the Shaw Attitude Toward School Subjects measures were proposed.
2. The students' interest in science was to be evaluated by comparing the number of elected science courses for the students who viewed the films and participated in individual and group counseling sessions with the electives for the students who did not view the films.
3. Students' information about science careers was to be evaluated by an unspecified measure based on the content of the role-model films.
4. Counselors' level of information about minorities was to be checked for both experimental and control group members by means of an unspecified test.
5. The number of counselor-parent contacts was to be tallied for both the experimental and control group counselors.
6. The degree of fit between the counselors' perception of students' values and the students' measured values was to be checked by the use of Rokeach's Value Survey.

This was the most comprehensive evaluation plan of any of the 11 projects in this program.

Evaluation Success

The delayed acquisition of both the counselor training films and the role-model films disrupted many of the project's plans, among them the plans to carry out the full range of impact evaluation initiatives. Only two prints of each film were made instead of the planned six, and this slowed their distribution to the schools. Thus, just a handful of schools finally received the role-model films, and some of those got them so late in the school year that student selection of the following year's courses had already been completed. Though the 10-minute films had been designed to be shown one at a time and followed immediately by group discussion of the issues raised, in practice all five films were shown together leaving virtually no time for discussion. Moreover, none of the counselors interviewed said that they had had more than routine contact during the school year with the students identified as "experimental" or "control."

Though the Kuder General Interest Survey and the Rokeach Value Survey were administered both before the in-service training and as it was nearing completion, no results are reported in the evaluation section of the project's final report even for the minority of the student participants who were able to view the role-model films. There is no indication of any attempt to collect either pre- or post-measures of student attitudes, student information about science careers, counselors' own information about minorities, counselor contacts with parents, or the number of students enrolling in elective science courses. After the strong evaluation plan outlined in the proposal, this nearly complete absence of implementation suggests that an alienation of Los Angeles County research department personnel took place quite early during the course of the project.

During the early part of the following school year, a post hoc analysis was attempted by the County Superintendent's Office. A five-item questionnaire was sent to the 23 counselors who had attended most of the training sessions. Twenty-two responses were returned, 18 from counselors who had viewed the role-model films. Responses were largely positive, but can be taken as only mild indicators of project success since three of the five questions requested the counselor's opinions regarding possible student benefits from having viewed the films. All of the questions could be answered with a simple "yes" or "no," although additional comments were solicited. Thus, there is just scant evidence that the counselor participants had changed any of their own behaviors as a result of the training program, and only second-hand information regarding possible impact on the student participants.

It is unfortunate that the objectives of this project were not achieved, because the films ultimately produced seem to be of high technical quality and apparently have been well received by non-project groups which have viewed them.

The AIR Study Director has screened the films and agrees that they could have considerable impact on counselors, teachers, students and parents if shown in an appropriately supportive context.

Summary Comments

To a very large extent, this project was severely crippled by circumstances beyond its control. Even with the problems the project faced, success would have been far more likely had project administrators been able to keep sight of the theoretical underpinnings included in the original project proposal. The project was designed to take place over a specific period of time (five months), to provide a non-threatening supportive training situation within which counselor self-criticism would be invited, and to allow specific strategies and materials to be tried out in the workshop setting and practiced (called "testing") by the counselor at his or her own work site. It was the information that the films carried which was important, not the physical availability of the films themselves. As circumstances prevailed, the project could have adhered to its objectives only by making concessions in the planned implementation; unfortunately, this was not done and the result is an attractive set of products whose efficacy has not been tested.

13. CASE STUDY--THE UNIVERSITY OF MICHIGAN

"Experimental Pre-University Course for Minority Entrants"
May 15, 1974--October 31, 1975

Original Brief Description

> A pre-university course of eight weeks will be conducted for minority group students during the summers of 1974 and 1975 to remedy poor preparation in elementary chemistry and mathematics so that the student participants can start their pre-professional training on an equal footing with their non-minority counterparts. These classes will be taught in two urban centers in Michigan by minority group lecturers.
>
> The course will be evaluated in association with the Coalition for the Use of Learning Skills (CULS), both immediately following the participants' initial experiences in the course and at the end of each term following their entry into the university. Those participating in the experimental course will be compared to two control groups consisting of (1) minority students who do not participate in the experimental course and (2) all other students in the introductory chemistry course.
>
> The main subjects to be covered will be basic mathematics and elementary chemistry; those considered prerequisite to any of the beginning chemistry courses at a pre-professional level.

This project was an expanded follow-on to a programming effort during the summer of 1973. Nearly all of the elements in the present program had been tried out during the earlier program and most of the staff involved in the 1973 program participated in the summer programs of 1974 and 1975.

Project Personnel

Administrative Staff:

Thomas A. Dunn*	Project Director Chairman, Department of Chemistry University of Michigan
Mohamed Talballa	Project Coordinator

Instructional Staff:

Mohamed Talballa	Instructor Graduate student, University of Michigan (1974 and 1975 summer programs)
Courtney Crim	Instructor Graduate student, University of Michigan (1974 and 1975 summer programs)
Seydou Diop	Instructor Graduate student, Wayne State University (1974 summer program only)
William Burge	Instructor Assistant Professor of Chemistry University of Michigan Flint Campus (1975 summer program only)

Participants: Of the sixty-odd students who had completed 1974 and 1975 mini-courses, most had gone on to Wayne State University or other universities, but about 40% were attending the University of Michigan. Seven of the latter participants were interviewed at some length.

Associated Non-Project Personnel:

Frank Yates	Former Director of Coalition for the Use of Learning Skills (CULS)
Vern Farmer	Former Director of CULS
Ray Snowden	Present Director of CULS
Nick Collins	Deputy Director for Evaluation of CULS

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*Individuals whose names are underlined have been interviewed.

The Context

At the University of Michigan, the Coalition for the Use of Learning Skills (CULS) was established in 1967 to provide tutorial assistance and guidance to minority students and others. CULS established study groups for special work related to several of the more difficult freshman and sophomore courses and these, along with the other CULS services, are taken advantage of by most of the nearly 3,000 minority students on the Ann Arbor campus. Similar assistance is available at the University of Michigan Flint campus.

By 1970, it had become obvious that minority students were having special difficulties with freshman chemistry. This was of particular concern since the chemistry course is a prerequisite to further course work in almost all of the science-related fields. Though a great many of the chemistry students were weak in the basic skills, deficiencies were more prominent among the minority students. In 1971, the Chemistry Department estimated that 30% of the non-minorities taking freshman chemistry failed to earn a grade of C or better, while for minority students, the figure was more than 50%.

In 1972, during the first two weeks of the first freshman term, CULS sponsored a special program to give minority students training in note-taking, test preparation, and other skills, but attendance was very poor, apparently because there were too many things competing for the freshman students' attention during their initial weeks on campus. Moreover, it was felt that remedial work in chemistry during the term was not really the answer because students had deficiencies in their chemistry and mathematics background which seemed to lead very quickly to discouragement during the first few weeks.

Thus it was that Tom Dunn as Chairman of the Chemistry Department, and Frank Yates, the Director of CULS at that time, planned a pre-freshman chemistry program to be held during the summer of 1973. It was decided that the program would be called a "mini-course" since it was designed to review the basics of high school chemistry and then to preview the essential elements of first-term college chemistry. The objective was to provide the participants with a greater sense of security about their chemistry preparation, as well as to mitigate the experience of "freshman shock" which frequently accompanies the pace and workload of introductory college chemistry.

Chemistry department funds were used to support three instructors, two of whom had previously worked with CULS programs, and CULS contacts in area high schools and among minority students on campus were utilized to recruit participants. The specific subject matter for the mini-course was decided upon by comparing high school chemistry syllabuses with the college chemistry syllabus and developing a teaching plan which emphasized the elements from the former which were necessary for an understanding of the latter. The mini-course was planned for two evenings a week plus Saturday morning at a location in downtown Detroit so that participants who had summer jobs could be accommodated.

Project Milestones

Based on the generally positive experience of the 1973 chemistry mini-course, the decision was made to solicit outside funding for a continuation and elaboration of the mini-course idea.

1973

Late summer	Dunn receives a National Science Foundation circular advising of the availability of funds for research projects related to increasing the participation of minorities in science and engineering careers.
Fall	It becomes apparent to Dunn that continued Chemistry Department funding of a mini-course during the summer of 1974 would be unlikely and he decides to search for outside support.
November/December	Dunn sends a brief proposal to NSF which includes a report of the 1973 mini-course.

1974

February 7	NSF responds to Dunn's pre-proposal and encourages a full proposal.
February 22	Formal proposal is submitted.
March 15-16	The NSF review panel meets to consider all of the proposals NSF has received in this funding category. The panel recommends project approval for the University of Michigan proposal.
Late March	Dunn receives a telephone call from NSF advising him of project funding at the requested level but cautioning him not to expend any funds until official notification is received.
Late March/ Early April	University of Michigan Administration Office supplies CULS with a listing of potential minority students accepted at the University for entry in September 1974.
April	CULS sends a packet of informational materials, including notice of the summer chemistry mini- course, to all potential minority students.
Late April/ Early May	CULS seeks out and contacts minority students attending freshman orientation week to advise them of CULS services, including the chemistry mini-course.
May 22	NSF letter of award sent to Dr. C. G. Overberger, Vice President for Research, University of Michigan.
Late May	Advertisement for the mini-course is placed in one of Detroit's Black newspapers and letters are sent to the principals of Black high schools where CULS had established contacts.
Late May	Dunn contacts Wayne State University (the other major potential recipient of mini-course graduates) to arrange for an instructor from that institution.
July 6	Starting date of the six-week summer program.
August 15	Ending date of six-week summer program.
September	Mini-course participants begin freshman chemistry course at University of Michigan and other schools.

1975

January	First-semester chemistry course complete.
January/February	CULS contacts William Burge at the Flint Campus at the University of Michigan and arranges for him to instruct mini-course students in Flint during the summer of 1975.
Late March/ Early April	University of Michigan Administration Office supplies CULS with a listing of those accepted for fall, 1975 who are likely to be minority students.
May	Minority students attending freshman orientation week at University of Michigan contacted by CULS and letters sent to high schools to solicit mini-course participants for the summer of 1975.
June 16	Letter sent by CULS to potential minority students strongly urging them to participate in the mini-course if they are planning to elect chemistry in the fall.
July 5	Six-week mini-course begins in Detroit.
July 7	Six-week mini-course begins in Flint.
August 14	Six-week mini-course ends in Detroit.
August 15	Six-week mini-course ends in Flint.
September	Freshman chemistry course begins.

Critical Steps

Program Definition

The study carried out at the University of Michigan utilizing NSF funding had very clear goals which were aided, of course, by the experience of the previous year. The project is cast in an operational, rather than a theoretical, framework built on a logical, experiential base. The program was carefully designed to avoid the possible stigma of being "remedial" and, at the same time, focused on a few carefully selected elements deemed essential to success in college freshman chemistry. The straightforward objective was to provide minority students with the basic educational tools and the self-confidence necessary for a positive experience with their first college science course in the expectation that fewer would then disqualify themselves from the pursuit of scientific or engineering studies.

Program Planning

Planning for the 1974 and 1975 period of NSF sponsorship closely followed that which had been tried out in 1973. The syllabus of instruction and the guidelines of the course were developed under the general supervision of Dunn, the Chemistry Department chairman, with the assistance of two other Chemistry Department professors. The summer work plan was based on an analysis of both high school and college freshman texts and was designed to concentrate on those elements of chemistry taught during high school which were basic to the understanding of college chemistry. These included mathematical skills and, as a result of the 1973 summer experience, the proportion of mathematics was increased for the 1974 and 1975 summer programs. One important aspect of project planning was the intended dovetailing of the mini-course experience with the further support the participants could expect from CULS during their college years.

Evaluation of two types was planned. Short-term assessment of students' skills development was to be made at several points during the progress of the mini-course and compared with a pre-measure made the first day of the course. For the longer-term evaluation, two comparison groups were proposed so that post-mini-course success in the freshman chemistry program could be evaluated. The comparison groups included one of minority students who did not participate in the mini-course but who did have other CULS support services available, and a second group composed of all other students in the introductory chemistry course. Test scores and final grades were to be compared across groups. Finally, it was planned to obtain subjective data from the mini-course participants concerning their self-perceptions of the effectiveness of the mini-course and the development of their skills with chemical and quantitative principles.

Staff Selection

The staff chosen to instruct the mini-course were, with one exception, required to be minority chemists with a demonstrated empathy for the problems of first-year minority students. It was planned to have an instructor for every 10 to 15 students and, since the six-week relationship was likely to be an intense one, it was deemed to be very important that the instructors be compatible with the students. In fact, the planned mini-course in Flint was not operated during the summer of 1974 because an appropriate instructor could not be located. William Burge, who taught the Flint program during the summer of 1975, is not Black but had been very successful as a counselor of minority students at the Flint campus of the university and was well known to CULS. Talballa, a doctoral candidate from Sudan had been instructing introductory chemistry courses since 1970 and had participated as a CULS tutor and leader of study groups continuously over that period. Crim was a very able Chemistry Department undergraduate who had assisted CULS in their tutoring program. He was made a part of the teaching team during the 1973 mini-course (before NSF funding) as an assistant to Talballa and had proven to be a very effective instructor. Seydou Diop was a graduate student at Wayne State University in Detroit and had also proven his effectiveness during the preliminary summer of 1973.

Participant Selection

Students were recruited for the program in a variety of ways:

- --A newspaper ad was taken in one of the Detroit area black newspapers.
- --The administrative office provided CULS with a listing of all the incoming students who had self-identified as minorities through application for special financial aids or who applied from high schools located in areas known to have a heavy minority population. These people were contacted by letter.
- --Minority students who attended the Pre-freshman Day and who identified themselves to CULS as part of the orientation program were given information about the mini-course.
- --The principal at each of the high schools with which CULS worked in their minority recruiting efforts was sent a letter advising of the availability of the mini-course program.

All of those students who returned a form indicating their interest in the mini-course were invited, along with their parents, to a meeting at the Rackham Extension Center in Detroit where Talballa explained the reasons for having the mini-course (high failure rate in chemistry, especially among minority students; first semester shock; competing with other good students for the first time) and what the mini-course was hoping to accomplish. He underscored the fact that the mini-course, while aimed specifically at the freshman chemistry program, would be dealing with skills that would be useful for college work in general, such as test-taking strategies, quantitative skills, etc.

All of the classes were held at the Rackham Extension Center in downtown Detroit, rather than at the Ann Arbor Campus, in order to make the mini-course available to students who had summer jobs. For the same reason, the classes were held two evenings a week and on Saturday morning. Forty-eight or 50 people originally applied for the 1974 program and about 35 showed up for the first class. For the 1975 summer program, there were many inquiries about the program and it was clear, during Talballa's visits to the various high schools, that there had been a lot of word-of-mouth encouragement from the 1973 and 1974 mini-course participants. Thus, it was not necessary to run a newspaper advertisement or to make the formal contacts with the high schools as had been done in the earlier years. By 1975, Seydou Diop had completed his graduate work at Wayne State University and was no longer available to teach the mini-course. As no other suitable instructor was available from Wayne State, the 1975 enrollment had to be limited to 55 people (who could be accommodated by Talballa and Crim in two day and two night classes at the Detroit location). Talballa estimates that about 15 additional people might have signed up for the course had the enrollment not been closed. Of the original 55 applicants, 40 began the course. An additional 15 students signed up for and took the mini-course program in day sessions at the University of Michigan Flint Campus located within the city of Flint.

Participants in the mini-course did not go through a project-initiated selection process; all who were interested were accepted. However, potential participants had already undergone two rigorous screening procedures:

one in order to be accepted at the University of Michigan or another university, and a self-selection when they decided which first-year courses to elect. Thus, despite the lack of a formal selection procedure for choosing participants for the mini-courses, the groups which attended were quite homogeneous with respect to general aptitude and immediate academic concerns.

For the participants, the incentive for successful participation was clear: an opportunity to solidify chemical principles taught during high school and to preview the kind of demands which would be made on them during their freshman chemistry course. It is difficult to think of any more motivated circumstance for someone about to embark on his or her college career.

Whenever a research project depends upon volunteer participants, there is a likelihood that self-selection will distort the outcomes and reduce the generalizability of the results. In this case, it seems possible that the most highly motivated minority students might be the ones who elect to participate in the mini-course. That is, mini-course participants may be predominantly made up of those students who would have been most likely to do well in freshman chemistry without the assistance of the mini-course. In that case, the mini-course would give the appearance of a success it did not earn. Conversely, it is equally possible that the students who are attracted to the mini-course are those with the most difficulties with science and math, and judgement about the impact of the program based on participants largely from this group would underestimate the potential applicability of the technique. An attempt was made to clarify this question at the time of the site visit to Ann Arbor. Talballa, the project coordinator, said that the students had come from a wide variety of Detroit high schools, not primarily from those that had the poorest science instruction. He also said that in his observation, the participants were not necessarily highly motivated; that, in many cases, the students were taking the course essentially out of fear--they were insecure about their chemistry preparation and did not know what to expect when they met strong university competition.

Programming Activities

Many of the project's program activities have already been alluded to. They were the same for both the 1974 and 1975 summer programs with only slight variations. Of the six weeks of instruction, the first 2-1/2 weeks were spent sharpening skills, with one week (three sessions of three hours each) devoted to improving study habits, and the other 1-1/2 weeks to the improvement of those basic quantitative skills necessary for the understanding of chemistry. The chief difference between the 1974 and 1975 mini-courses was that in the latter, somewhat more emphasis was placed on the material covered during the first half of the freshman chemistry course rather than providing a more even overview of the whole of freshman chemistry.

The specific topics covered were determined by Thomas Dunn and two other members of the Chemistry Department staff after an analysis of several high school chemistry texts and the freshman chemistry text to determine which elements were the essential ones required for understanding of college chemistry. Except for the slight variation noted immediately above, the syllabus of instruction was the same for the 1974 and 1975 mini-course offerings (and the same for both the Detroit and Flint locations in 1975). At the first meeting of the mini-course each year, a lengthy diagnostic test was administered to the participants to ascertain their quantitative skill level. This measure was then used to divide the group into classes according to skills so that an increased amount of time could be spent with those students whose skills were poorest. The quantitative diagnostic test was administered again at the end of the course as a guide to the degree of improvement achieved by the participants. A mid-term and a final examination of chemistry principles were also administered. These, too, were used diagnostically. No grades were assigned to the students' work, since these measures and a very low student-to-teacher ratio (10 to 12 students per class) allowed a more direct method of feedback of skills achievement to the participants.

Program Evaluation

The fairly elaborate plans for program evaluation outlined in the proposal were not completely carried out. A research report of the evaluation of the 1974 mini-course was prepared by CULS and includes much pertinent information, but changes in both the directorship and in the research division of CULS during 1975 disrupted intentions to publish a similar technical report for the 1975 mini-course.

In 1974, the mini-course effectiveness was evaluated by comparing the chemistry course performance of mini-course participants with that of other minority students who had not attended the mini-course but who had participated in a CULS study group, and to a control group of primarily non-minority students who had received no academic supportive service. T-tests were performed among mean scores for a number of variables including three departmental examinations, the final examination, a composite score of all examinations, a laboratory score, and grades earned in lecture and in the laboratory. Those results indicate that mini-course participants did significantly better than the control group on the first departmental exam, on the chemistry laboratory score, and on the composite score of all examinations, while there were no statistically significant differences between those two groups for the other variables. The differences in performance between the mini-course participants and the CULS study group participants were not significant on any of the variables.

A similar weak advantage had been reported for mini-course participants who had attended during the summer of 1973. Scores on three one-hour exams, the final exam, and the chemistry laboratory were compared for the mini-course participants and study group participants. The results showed a consistent, though not significant, difference in favor of the mini-course participants on all five measures. The distributions of final chemistry grades were also shown for the mini-course participants, the study group participants and the entire group of more than 1,000 students who took the first-year chemistry course. Though the number of people from the mini-course and from the study groups was very small (14 and 19, respectively), a comparison of the grades earned by the two groups showed a slight advantage in favor of the mini-course participants. This difference, again, was not significant.

The grade distribution shows that, proportionately, mini-course and study group participants failed the chemistry course (D or F) at a rate more than twice as high as for the non-minority students.

These results underscore the fact that severe methodological problems have prevented a realistic analysis of the impact of the mini-course. This, of course, would be equally true had the reported research shown extraordinary differences in favor of the mini-course participants. Part of the problem stems from the fact that specific behavioral objectives of the mini-course were never spelled out. Had they been, appropriate tests of whether or not those objectives had been achieved could have been devised. For example, if one objective had been to help the students avoid the negative experience of failing a first-term freshman course, it would have been important to follow up those mini-course students who, on the basis of their foretaste of chemistry, decided not to take the freshman course after all; if an objective was to provide the basis for the achievement of better grades among those students who did take chemistry, the essential importance of a measure of the knowledge of chemical principles of entering students, both minority and majority, would have been obvious.

Interviews with several of the mini-course participants suggest that there were several important outcomes. As has been reported in numerous studies over the past 15 years, minority students often feel under considerable psychological pressure when they have to compete with non-minority students in circumstances where the minority students have not yet demonstrated competence. This reaction would normally be expected to compound the problems caused by the usual "freshman shock." But, the experience of one of the mini-course participants interviewed was also mentioned by several of the others. He said that since the mini-course class was mostly Black, he felt more at ease with the learning and the mini-course gave him a "feeling of preparedness when it came time to compete with Whites in the chemistry class." In addition, almost all of the participants interviewed spoke without being prompted about an improvement in their self-confidence regarding both specific mathematics and chemistry skills and their ability to handle college level work.

One other outcome is worth mentioning. During the interviews, the participants were asked if they would recommend the mini-course to younger siblings or friends. The response was invariably an enthusiastic "yes," generally followed by a recitation of examples of people who *had* enrolled in the mini-course at their suggestion.

Thus, despite the lack of formal evaluation, there are indicators to suggest that the mini-course fulfilled an important function for the minority students who participated in it. It gave them a realistic preview of both the content and the difficulty level of the freshman chemistry program and has thus acted as an aid to the participants as they decided whether or not to pursue a scientifically oriented course of study. And, for those who decided to do so, the mini-course seems to have improved their confidence in their own abilities to compete successfully with non-minority students. Finally, the mini-course provided an opportunity for students to test their own study skills at a point in time when the cost (normally, falling behind in course work, poor grades or failure on hour exams, or even course failure) of repairing deficiencies is not great.

Summary Comment

The mini-course idea has a number of things to recommend it as a technique to reduce failure and drop-out rates of minority students in science courses. Though the program's instructional benefits may not be greater than the benefits from other kinds of assistance, such as tutoring or study groups, it would seem to have advantages in its ability to recruit participants by operating on their own territory and accommodating to their needs to hold jobs during the summer period. The approach provides a high teacher-to-student ratio at very moderate cost by its use of empathetic graduate students as instructors. Finally, the mini-course seems to generate an enthusiasm and self-confidence in its participants which, in itself, is a valuable attribute in a competitive situation, whether a chemistry class or any other endeavor.

14. CASE STUDY--THE UNIVERSITY OF NORTH DAKOTA

"An Experimental Pre-Professional Summer Institute for American Indian Students in Engineering"

May 15, 1974--November 30, 1974

Original Brief Description

> The University of North Dakota will conduct a summer training program in engineering for 20 native American students. The primary objective will be to help immediately qualified Indian students to enroll in an engineering school (University of North Dakota) and to help Indian-controlled junior/community colleges develop pre-engineering and engineering science curricula. The American Indian Higher Education Consortium, Incorporated (AIHEC) will act in concert with the University of North Dakota in carrying out this project.

This project was plagued by a series of problems stemming from both within and outside. Though the project did not reach its original objectives, the sequence of events has been fairly well documented and a great deal has been learned which can be of use to other projects as well as to the National Science Foundation.

Project Personnel

Administrative Staff:

Art Raymond*	Project Director Director of Indian Studies University of North Dakota
James Hudson	Project Coordinator Engineer for the Indian Health Service

Instructional Staff:

Edward O'Reilly	Professor of Chemistry University of North Dakota
John Crawford	Associate Professor of English University of North Dakota
Paul Flasch	Instructor of Mathematics University of North Dakota
Harold Hjalmarson	Instructor of Physics University of North Dakota
Tim Hung	Instructor of Engineering Graphics University of North Dakota
Keith Miller	Tutor/Counselor
David Garcia	Tutor/Counselor

Note: Both Miller and Garcia had left the University of North Dakota and could not be traced, but each left a detailed critique of the summer program as his contribution to the final report.

Participants: Of the 14 participants, only one was still located in the University/Grand Forks vicinity. He could not be contacted during the period of the site visit and did not respond to a request through the Office of Indian Studies to telephone an AIR interviewer.

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*Individuals whose names are underlined have been interviewed.

Associated Non-Project Personnel:

Allan Fletcher	Dean of the School of Engineering University of North Dakota
David Gipp	Director of the American Indian Higher Education Consortium Denver, Colorado
Jean Moore	National Academy of Engineering of the National Research Council Washington, D. C.

The Context

There are two elements to the context in which the University of North Dakota project was launched. The first of these was an initiative by the Commission on Education of the National Academy of Engineering to establish four to five institutes for the summer of 1974 to facilitate the transfer of qualifiable minority students from junior/community colleges to schools of engineering at an early point in their educational career. It was intended to establish pilot institutes for specific minority groups (Black, Puerto Rican, American Indian and Mexican American/Chicano) in order to provide an experience base for subsequent continuation and expansion of the institute program idea. Early contacts had been made with the American Indian Higher Education Consortium in Denver, an association of Indian-controlled community colleges, and the United Tribes Training Center of Bismarck, North Dakota.

The second element of the context stems from some concerns of Art Raymond, the Director of the Office of Indian Studies at the University of North Dakota. Raymond, a Sioux, was keenly aware, through his brother who is one of the very few native American engineers in the country, that very few Indian students were selecting engineering as a field of study. He was also aware of the great need on the reservations for engineers of various sorts.

The University of North Dakota, at that time (late 1973) had a large number of native American students among its student body. It provided several special programs directed toward overcoming these students' educational deficiencies and helping them to bridge the gap between their typically segregated experience on the reservation and the powerful new experience of being at a very large, white university. The most successful of these efforts had been the INMED (Indians Into Medicine) Program. Raymond had been involved with it and he felt that a similar type of broad-scale effort aimed at potential engineers would also prove to be beneficial.

The two elements came together when both the American Indian Higher Education Consortium and Raymond contacted the Dean of the College of Engineering at the University of North Dakota, Alan Fletcher, for assistance in developing a project to facilitate the entry of the native American students to engineering study.

Project Milestones

Beginning with the setting briefly described above, the following are the critical milestones in the history of the project.

1973

Spring	National Academy of Engineering representative contacts Fletcher regarding the possibility of making the University of North Dakota a regional center for minorities in engineering with the capability of enrolling 100 students per year.
Mid-year	Raymond writes a concept paper (for internal university distribution) for a program for Indians in engineering based on the idea of a four-year involvement. Support from Indian tribal organizations was solicited.
October/November	David Gipp, the Director of the American Indian Higher Education Consortium (AIHEC) is contacted by Lois Steel, the Director of the INMED Program at the University of North Dakota and is invited to attend a meeting at the university with Steel, a representative of the National Association of Engineering and two or three others, but not including Art Raymond.

1973

October/November	The United Tribes of North Dakota is contacted by Steel and became involved in project planning. The United Tribes training facility in Bismarck, North Dakota is suggested as the project site.
December	A preliminary proposal is submitted by Gipp to the Commission on Education of the National Academy of Engineering for a summer training program for 100 Indian students. The United Tribes of North Dakota is named as a cooperating agency as is the Engineering Department of the University of North Dakota which is to supply instructional assistance.

1974

January	A preliminary proposal from the Commission on Education of the National Academy of Engineering to the National Science Foundation is submitted. In this document, five separate summer institutes are proposed, each to serve a specific minority group.
January	NSF's informal response to the NAE preliminary proposal is that the scope is too large, but that NSF would entertain proposals from the specific institutions on an individual basis.
February/March	A new proposal is sent to NSF authored by AIHEC and the University of North Dakota College of Engineering outlining a 10-week summer program for 20 Indian students.
March 15-16	The NSF review panel meets to consider all of the proposals NSF has received in this funding category. The University of North Dakota project is recommended for approval.
March 25	A new proposal is sent to NSF authored by AIHEC, University of North Dakota School of Engineering, and the University of North Dakota Office of Indian Studies. This proposal is apparently in response to an NSF request for further elaboration of the program objectives and budget of the earlier proposal.
Mid-March	NSF informs Fletcher that funding for the project would be dependent on the formal organizational involvement of the University of North Dakota.
Early April	Hudson is asked by Raymond to be the Project Coordinator and meets with AIHEC representatives and others at the University of North Dakota.

1974	
April 17	A new revised proposal is submitted to NSF by the University of North Dakota Office of Indian Studies supported by the INMED Program and the College of Engineering. There is no mention of AIHEC and the participants are now to be selected from "native American applicants" rather than the earlier "community college applicants."
April 25	Recommendation forwarded within NSF that a grant be made to the University of North Dakota. The memo bears the notation that "the Sloan Foundation will provide additional costs, including student stipends, and the Bureau of Indian Affairs will provide two laboratory training assistants" and also says that "the American Indian Higher Education Consortium, Incorporated (AIHEC) will act in concert with the University of North Dakota in carrying out this project."
Mid-April	Selection of potential instructors for the summer program is begun.
Mid-April	Hudson begins word of mouth advertising for potential participants at Indian community colleges and at a number of Indian reservations in the general vicinity.
Late April	Gipp, Hudson, Fletcher, Raymond, and others meet at the University of North Dakota to discuss the curriculum for the summer program.
May 15	The University of North Dakota school year ends.
May 16	NSF sends letter of award to Dr. Thomas J. Clifford, President of the University of North Dakota.
Late May	NSF award formally accepted by the University.
Late May	Hudson contacts all of the community colleges he had previously canvassed and which had promised cooperation, but finds that, without exception, they have completed their school year and no students are available on the campuses.
Late May	Hudson travels from his home in South Dakota to the University of North Dakota stopping at a number of Indian reservations along the way in order to recruit participants for the summer program.
June 1	Hudson starts work at the University of North Dakota and almost immediately leaves on another recruiting trip because there are commitments from so few participants.

1974	
June 16	The summer program starts one week late with eight students in attendance.
Late June	Miller, one of the tutor/counselors, approaches Raymond and Hudson to discuss the difficulties the participants are having with the length of the academic day.
Late June/Early July	Participants continue to arrive at the University of North Dakota until, by July 8th, there are 14 of them.
Late June/Early July	The project's instructors meet with Raymond and Hudson to complain about the lack of attendance on the part of the participants.
Early/Mid-July	Participant attendance at classes drops to a handful and, in the case of the English course, to zero.
Mid/Late July	Some of the students begin to talk of dropping from the program and three actually do leave.
August 24	The summer program comes to an end.

Critical Steps

Program Definition

The originators of the University of North Dakota project produced several (at least four) proposals, each differing to greater or lesser degree from previous ones. Over time, these proposals became more focused and achieved better definition. Because the present participation of American Indians in engineering fields is so tiny and the need for intervention strategies of every kind so obvious, it was apparently assumed by both the originators of the project and by NSF that almost any coordinated effort by people familiar with the problem area would be likely to have a positive effect. This point of view allowed several project elements to remain incompletely developed.

The proposal of February/March, which is the one acted upon by the NSF review panel, and the revised proposal of March 25, 1974 both state that the primary objective "is to help immediately qualifiable Indian students enroll in engineering school (University of North Dakota)." There is no elaboration, but conversations with project personnel have revealed that the intent, when the earlier proposals were being written, was to assist the project participants as they attended regular pre-engineering summer session courses at the University of North Dakota. The issue was obscured by the fact that a tentative class schedule was included in the early proposals which showed 28 class-hours a week in mathematics, physics, engineering graphics, chemistry and reading; a schedule somewhat more rigorous than the usual summer student is expected to maintain. This would seem to imply that special instruction was planned, but there was no budget item to cover teacher salaries.

By the date of the last proposal revision in mid-April, the plan clearly was to provide specially tailored classes for the participants and the budget included salaries for two full-time teachers.

There was no indication in either the budgets or in the texts of the several proposals of when the special materials would be prepared or how they were to be paid for. Interviews with the project instructors indicated a lack of consensus about the degree to which the instruction was to be remedial and the degree to which it was meant to be an introduction to the field of engineering. This would seem to suggest that the specific goals of the project were unclear to some of the project administrative personnel as well.

Program Planning

Planning of the program at the University of North Dakota seems to have been casual in many respects. Whatever goals were finally adopted by the program, the paths to those goals were incompletely spelled out. The proposals include no details of how the participants (who were expected to be at the fifth- or sixth-grade level in mathematics, science, and language arts) were to be brought through a very concentrated program of university level pre-engineering courses with enough individual success to be ready to elect engineering as a course of study during the following school year.

Hudson, a Sioux, said that his original concept of instruction was for a curriculum with courses coordinated in terms of content and pace in a way which made them intermesh with each other and with Indian experience. He explained that this would have provided a "closed system" of the sort

Indians feel more comfortable with, rather than an open-ended situation which traditionally is to be avoided. The details of this are not important here; what is important is that Hudson was attempting to give this program an Indian basis. He advanced his ideas at an early meeting at the University of North Dakota, but because of the late funding and the necessity for him to spend the first several weeks of his employment recruiting off-campus, he was not available to promote the adoption of his concept during that critical time when the final arrangements were being made.

Budgeting was also a problem. Many revisions of the budget were required by NSF before the project was approved by them, but even the most recent form of the budget provides scant justification for some items. No time-line is included, so it is unknown whether the line-item for instructional staff salaries was meant to cover just the 10 weeks of the summer program or whether it also covered a pre-planning period for the construction of the specialized curriculum. The line item for staff travel is justified by citing the need for recruitment trips to 22 reservations at an average estimated cost per trip, but there is no explanation as to why several trips could not be combined, why personal visits were required, or who was to do the recruitment.

There was no specific plan for evaluation in either the proposal approved for funding by NSF or any of its other versions. It was clear from conversations with Raymond that he felt that project success could be measured very simply: Since there were about 300 Indian students at the university, but only one or two of them had attempted an engineering program, any post-project interest in engineering on the part of the participants would be cause to term the project a success. This reasoning is fallacious because the very wide recruiting sweep of Indian reservations could well have selected a significant portion of those Indian youngsters who were intending to enter the field of engineering in any case.

Staff Selection

Since none of the teaching staff in the Department of Engineering were native American, an attempt was made by the project administrators to recruit instructors who had had experience teaching Indians participating in one of the several specialized programs on-campus. Dean Fletcher of the engineering department proposed the teaching staff he thought would be effective and his nominations were approved by Art Raymond. Delayed funding required some changes, but seasoned staff was assembled and the final group of five included a full professor, an associate professor, and three instructors.

Some of the participants reportedly had difficulty relating to some of the teaching staff and, though this could not have been anticipated beforehand, it might have been obviated by some specific cross-cultural training for the instructors and by better coordination between the instructors and project staff. Prior to the start of the program, Raymond did have a half-day session with the instructors to help them be able to react to the Indian ethnic qualities of the students. Thereafter, they had weekly meetings to discuss specific student problems, but the rapidity with which difficulties developed over the first two weeks of the project suggests that more of both of these activities would have been a good idea.

Participant Selection

In a situation such as the one in North Dakota where qualified individuals are expected to be relatively scarce in the general population, the recruitment and selection processes become vitally important. The original conception was of a very wide recruitment area with concentration on applicants who had an expressed interest in engineering. Preference was to be given to students who were attending or who expected to attend community colleges. Selection was to be on the basis of past performance and a review by a three- to six-person panel expected to include the program director, a member of the College of Engineering, one or more representatives from the reservations, an Indian engineer from the area, and Indian Health Service representatives. This seems like an excellent plan for acquiring participants. Several of the people associated with the project agree that the identification and selection of participants was expected to be a lengthy task requiring about three month's time.

However, a May release of NSF grant monies coupled with a University of North Dakota summer session which began in late May, reduced the recruiting effort to a quick sweep of nearby reservations to fill the 20 vacancies which had been funded. The selection panel was never constituted, transcripts and test scores of the applicants were never acquired, and the Indian community colleges had been dismissed for the summer. Apparently the sole criterion of selection ultimately used was the individual applicant's expression of interest in engineering. According to Hudson, who did the recruiting, the students who were available that late into the summer were those who were "just lying around;" the marginal people who had not been able to find summer jobs and who were not involved in summer schools or other specific activities. Hudson said that his feeling at the time was that if the project could reach those students it could reach anyone, and he was willing to try that.

This lack of selectivity very quickly became the crux of the project because the group which arrived at the University of North Dakota was not the originally-expected, highly motivated community college or pre-college students with engineering interests. Instead, the group actually included many high school students whose commitment to engineering was open to question and whose academic qualifications were unknown. They arrived to find a program of instruction much more concentrated than most had ever faced before, and with extremely technical subject matter for which few had the necessary background.

Management

Given the initial decision by the University of North Dakota to carry out the summer program even though proper participant selection was not possible, day-to-day management of the summer course seems to have been quite effective even though numerous difficulties stemmed from that decision. The transition from Raymond, who wrote the proposal and initiated project implementation, to Hudson, who took over the effective directorship soon after the project was funded, seems to have been carried out smoothly.

There is some indication, however, that Hudson, because of his youth and "outsider" status, had difficulty affecting the behavior of the two older instructors. He was not able to get them to coordinate their topics or to relate their instruction to the reservation experience. There is also some evidence to suggest that there were impediments to free communication among the project staff. The English instructor, an associate professor, complained that he was frequently not informed of meetings or changes in the time or place of meetings and that, as the only instructor not from the engineering department, he felt excluded. These events may possibly be related to the fact that Raymond was considered by most of the staff to be the parent of the project. By the second or third week of the program, however, Raymond's regular duties as Director of Indian Studies prevented much direct contact, though he did remain available for consultation.

Programming Activities

There were three separate programming efforts which went into this project: an instructional activity, a tutoring/counseling activity, and a series of outside speakers. It had been assumed that the student participants would have various deficiencies in their academic background relative to the subject matter being taught during the summer program, so it was planned to have a tutor/counselor sit in all of the classes and be available to provide assistance on an "on call" basis, day or night. The tutor/counselors lived in the dormitory with the participants and helped to arrange special activities for them for evenings and weekends.

The planned instructional activities were less considerate of the participants. The teaching plan was determined well before any participants had been recruited and was based on presumed deficiencies in the academic background of the applicant population. With those assumed to be very large, the teaching schedule became very heavy. There was no apparent effort made to match the instructional schedule to the needs of the specific individual participants; either those who were expected, or those who actually attended the summer session. When the participants complained about the very heavy class schedule, outside activities were interspersed more freely among the classes, but the actual number of hours of class instruction was not reduced.

Several cooperative activities with outside elements were originally planned for this project. Arrangements had been made with the regional office of the Bureau of Indian Affairs to have two native American lab assistants participate in the program to act as role models and give informal tutorial assistance. Though this resource was not utilized because it was felt that the program was already adequately staffed, an agreement was carried out with the Indian Health Service to provide engineers to visit the project, make formal presentations, and spend some time with the Indian students. Judging by the attendance at these sessions and instructor interviews, the students were enthusiastic about this aspect of the program.

In the original proposal to NSF, a coordinated effort with the American Indian Higher Education Consortium (AIHEC) was planned. The idea was to utilize the AIHEC contacts with Indian controlled junior/community colleges as a source of project participants and, in return, the summer engineering program staff was expecting to help the colleges develop pre-engineering and engineering science curricula. But, as related elsewhere, the late recruitment effort of the project prevented any effective utilization of AIHEC contacts, and apparently the lack of experience with participants at that level prevented the summer program's staff from making any curricula inputs to the community colleges.

Program Evaluation

As noted briefly above, this project did not include an organized attempt at program evaluation. The planners felt that if any of the participants were able to enroll in an eingineering curriculum after the summer project was complete, it would be a positive outcome from their point of view. In the project's final report, written at the end of the school year following the summer program, the project director recounts that of the 14 formally enrolled students in the summer program, six had entered college. Four of those were at the University of North Dakota, but not in the engineering department. In addition, there were two students who participated but were not formally enrolled in the project and one of them reportedly did matriculate in the College of Engineering at the University of North Dakota. Comments from two of the instructors indicate that this one person had been very positively affected by a combination of the program and the people associated with it.

There was one major unanticipated consequence of the summer engineering program. The difficulties it had encountered became widely known around the University and generated a certain amount of negative publicity. Project personnel had taken some early steps toward finding additional funding for a second summer program which could operate without the disadvantages of the original and would have the benefit of the first summer's experience, but the bad "image" caused by the first summer's problems resulted in this effort being aborted before it had progressed very far.

Summary Comment

As originally laid out, this project had the opportunity to be a fair test of the hypothesis that a concentrated summer program was a useful strategy for identifying and, to some degree, rectifying the academic deficiencies of native American students interested in engineering careers. The project concept was patterned on a successful program in the medical field and had the benefit of the experience of that program in dealing with identification, selection, and training problems of Indian students. It had been planned to recruit over a very wide area, and final selection of the 20 participants was to be done on the basis of a variety of academic and motivational criteria. Funding which arrived much later than expected prevented adequate recruitment and selection of the participants which, in turn, led to the many problems which disrupted the program and prevented it from being a reasonable test of the intervention technique originally proposed.

15. CASE STUDY--OLIVE-HARVEY COLLEGE, CHICAGO

"A Pre-Engineering Summer Institute"
May 15, 1974--January 31, 1976

Original Brief Description

> A pre-university course of eight weeks will be conducted for 50 minority students during the summer of 1974 to prepare promising high school and community college students to successfully meet the academic requirements of any first-year comprehensive engineering program. The program will be taught at Olive-Harvey College.
>
> The training will be evaluated by utilizing the mastery of learning technique in which a periodic statistical analysis of comparative scores of students in the experimental program will be compared to those in the regular Olive-Harvey Pre-engineering Program.
>
> The main subjects to be covered will be mathematics, chemistry/physics for engineers, and "Man and His Environment." Report writing and English skills will be emphasized in this last course.
>
> Arrangements have been made to have students who successfully complete this program enter Cornell University, Illinois Institute of Technology, or the University of Illinois.

A late start prevented this project from being able to recruit participants in the numbers with which it was expecting to work. As a result, the project still had considerable unexpended funds at the end of the summer of 1974 so, with NSF approval, it conducted the program a second time during the summer of 1975. Thus, there was the unusual circumstance of a project having an opportunity to refine its programing on the basis of a full-scale trial run. Unfortunately, despite this chance, administrative problems prevented an effective second effort.

Project Personnel

Administrative Staff:

Charles C. Kidd*	Project Director President, Olive-Harvey College
Clyde Williams	Original Project Coordinator Director of Communications Skills Olive-Harvey College
George Hansberry	Project Coordinator during the second summer of operation Chemistry Instructor Olive-Harvey College

Instructional Staff:

Thomas Nabih	Chemistry teacher during the first summer and operating Project Director during that time
Joseph Smith	Math Instructor during the first summer
John Sims	Physics Instructor during the first and second summers
Angela Boone	Biology Instructor during the first and second summers
Willie Black	Math Instructor during the second summer and acting Project Director and Coordinator during that time Chairman, Mathematics Department Olive-Harvey College

Participants: Eighteen participants were enrolled during the first summer institute and an additional 25 during the second summer. At the time of AIR's site visit in February of 1976, the student records from the 1974 summer program were apparently unavailable to the acting Project Director, Willie Black. The 25 people who had attended during the summer session of 1975 had come from high schools spread widely over the city of Chicago and Dr. Black indicated that it would be very difficult for him to make arrangements for any of those students to be interviewed, so the matter was not pressed. However, the Olive-Harvey Office of Institutional Research carried out a follow-up study of 20 of the students from the summer of 1975 and the questionnaire results were made available to the AIR Study Director.

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*Individuals whose names are underlined have been interviewed.

Associated Non-Project Personnel:

Eugene Speller	Current President Olive-Harvey College
Homer Franklin	Vice-President Olive-Harvey College
Cy Pernell	Operator of a social service agency for minority youths

The Context

Olive-Harvey College is a minority institution (the only such among the 11 grantees in this study) located on the south side of Chicago. It is part of the City College system and services a large, predominantly minority community with both day and evening courses, including a pre-engineering course.

Charles Kidd became president at Olive-Harvey in 1973. He had done his graduate work at the University of Michigan in engineering and, while there, had participated as an advisor and tutor in the Coalition for the Use of Learning Skills (CULS) program of assistance to minority students. After receiving his degree, he provided counseling assistance to the Society of Black Engineers at the University of Michigan. Thus, by the time he arrived at Olive-Harvey, he was quite familiar with the range of problems encountered by minority students, especially blacks, trying to pursue an engineering degree. At Olive-Harvey he saw the same thing that he had seen among the students he had been working with through CULS: poor preparation in many subject fields, and high dropout rates.

Kidd's concern for minority students interested in engineering led to discussions with the National Academy of Engineering and, subsequently, to an agreement to have Olive-Harvey act as a regional center for the National Academy's proposed plan for a series of summer institutes for minority students to be held throughout the country.

Project Milestones

1974	
February 11	Kidd submits proposal for participation in the National Academy of Engineering series of summer institutes.
February 15	NAE forwards Kidd's proposal to the National Science Foundation as a project which NSF might consider funding on its own merits rather than as part of the package of projects originally submitted by NAE and turned down by NSF.
February 28	Kidd's submission is treated as a pre-proposal by NSF and, since it is already very late in the decision process for the program, NSF telephones Kidd to invite him to submit a formal proposal.
March 7	Kidd submits full proposal to NSF.
March 15-16	NSF Review Panel meets to consider all of the proposals received in this funding category. Olive-Harvey project approval recommended.
May 22	Letter of award sent by NSF to Dr. John Taylor, President of the Board of Junior College District #508.
Early June	Kidd learns that an award has been made.
Late June	Grant acceptance is formally voted by the Central Board of the City College system.
June 28	The summer training institute begins.
August 15	Summer training institute ends.
August 21	Because of late start and the difficulty of finding suitable participants, Kidd suggests to NSF that the unexpended project funds could be used to mount a second summer program.

1974

September 27	NSF sends letter to Kidd advising him that summary information about the first summer's activities was needed before a decision could be made regarding the utilization of unexpended funds for a second summer program.
October	Hansberry arrives to fill a staff position and to direct the second summer's project activities if they are approved.

1975

January 28	Kidd sends a report of the 1974 summer training institute to NSF.
February 14	NSF approves Kidd's request to utilize unexpended funds for a second summer program.
June	Kidd submits his resignation to Olive-Harvey College.
June 23	Second summer training institute begins.
July	Kidd goes on leave from Olive-Harvey College and is unavailable to the project.
July 31	Kidd's final official day as president of Olive-Harvey College.
August 15	Summer program ends.
August 31	Hansberry leaves Olive-Harvey College.

Critical Steps

Program Definition

The objective of the Olive-Harvey program is clearly stated and relatively modest: to prepare promising high school and community college students to meet the academic requirements of any first-year comprehensive engineering program. In other words, it was planned as a remedial program to bring already acquired academic skills up to the level of quality required by engineering schools for successful entry.

The proposed general approach was to give the participants an opportunity to engage in problem-solving, goal-directed activities with a range of difficulty within their probability of success. One aid for bringing this about was the Mastery of Learning technique to be employed in the instructional plan. This system guides students to successively more difficult plateaus of understanding, each based on mastery of the earlier, less difficult levels. Thus, the objectives and the paths to those objectives were set out quite clearly prior to the initiation of the program.

Program Planning

While the process for achieving program goals was not elaborately spelled out in the proposal, execution of the program was in the hands of professional educators who would be carrying out a process with which they were fully familiar. The only difference between regular Olive-Harvey students and the expected project participants was that the latter would be more homogeneous in their goals than was usually true of students being taught at this level.

It was planned to recruit two types of participants: high school students who had been admitted to the Olive-Harvey Pre-engineering Program (an already-established two-year engineering preparatory program) and science-oriented college-bound students from area high schools. No specific selection criteria are stated in the proposal and it is not clear how the selection process was expected to differentiate those students with an engineering interest despite deficient academic credentials from those whose credentials were already adequate. The proposal is equally unclear about the differences in content of the proposed summer program from that of the regular Olive-Harvey Pre-engineering Program, except that the summer program student/staff ratio was planned to be seven to one.

The proposal was weakened by the fact that no evaluation plan was elaborated. The "meters of success" listed under the heading of "evaluation" are really statements of expectation; i.e., hypotheses. There are no words in the proposal which describe what data would be collected to test these hypotheses. Nevertheless, no further detail was requested by NSF before it approved funding of the project.

Staff Selection

As was true with most of the other projects which involved summer programing, late funding from the National Science Foundation disrupted recruitment at Olive-Harvey as well. Project plans had called for the employment of two instructors plus a project coordinator who would also serve as the third instructor. As the summer drew closer with no funding announced, two of the original three people who had been asked to work on the project withdrew, including the originally desired project coordinator. Then, when the award was made and funds did become available in June of 1974, a rushed effort was necessary to staff the project. Clyde Williams, who was then the Director of Communication Skills at Olive-Harvey, agreed to assume the position of Project Coordinator as one of his regular duties (and was not paid from project funds). Since only one of the original three people was still available and Williams could not teach a science course, two additional instructors had to be recruited. As it turned out, the circumstance resulted in a benefit to the project since the two people found, Thomas Nabih and John Sims, were not regular instructors in the Chicago City College system and their salaries were less than had been budgeted for those positions. This enabled the project to hire a fourth instructor, Angela Boone, to teach a biology course.

The resultant teaching staff included considerable expertise with both college and high school students. Joseph Smith, the mathematics instructor, had taught high school for about eight years. Nabih also had had many years of experience with high school students. All of the instructors were young Black scientists who could serve as excellent role models for the summer pre-engineering institute participants.

Participant Selection

The late funding was far more deleterious to participant selection than it had been to staff selection. Through regular Olive-Harvey contacts with high schools and through the personal efforts of several people on the Olive-Harvey staff, preliminary recruiting had begun well before the June starting date of the project. Brochures had been printed up and application forms sent out. Many students had indicated interest in the project and 55 applications had been examined by the college administration staff. As of June 1, 1974, after review and examination of transcripts and other application materials, 30 candidates had been identified for selection. It was a few days later that the project received notification of NSF funding. By the time the Board of Trustees had formally voted acceptance of the award and subsequent staffing was completed, the number of selectees who had not made alternative summer plans had dropped to 18. Though original plans had called for 50 participants, no last-minute recruitment effort was initiated as it was felt that people with the desired background could not easily be found. Thus, the delayed funding resulted in a significant decrease in the quantity of student participants but was not allowed to have much impact on their overall quality.

The small number of participants during the first summer program (and the associated cost savings) prompted an early request by Kidd to NSF for permission to conduct a second summer institute with the project's unexpended funds. This request was granted on February 14, 1975. There should have been ample time for recruiting and planning for the second summer, but critical personnel turbulence had taken place: Neither Williams, who had left Olive-Harvey, Nabih, nor Smith were available to the project for its second summer. Moreover, Kidd had applied for a position at Chicago University and was in the last stages of negotiation as summer approached. He announced his resignation from Olive-Harvey in June.

Thus, the only holdovers from the first summer program were Boone, the biology instructor, and Sims, the physics instructor. Both of these people had been neophyte teachers during the summer of 1974 and neither had organizing experience.

Meanwhile, Willie Black had come to Olive-Harvey as Chairman of the Mathematics Department, and George Hansberry had been recruited by Kidd to chair a new Natural Resources Department and to direct the second summer's Pre-engineering Institute.

The situation in the spring of 1975, when recruitment of the student participants for the summer program should have begun, was that Hansberry, having come from another state, had no local high school contacts and had to utilize formal channels of recruitment since Kidd had already disengaged himself from the project. Hansberry was assisted in this effort by Cy Pernell, who operates an agency which places high school students in special programs, and who knew the counselors and school officials at most of the high schools. However, Willie Black relates that when he joined the program at the start of the summer, very few students had been lined up. Black said that he used his high school contacts to stimulate applications and, ultimately, there were about 70. Each of the applicants was telephoned by a member of the project staff and questioned about his or her math and science background. Hansberry recollects that selection decisions were made on the basis of "general academic standards and math achievement level," but apparently the project staff did not have student academic records on hand.

About 45 students were accepted of whom 31 registered on the first day of the summer program. Most of the participants had just completed their junior year in high school, but five were only sophomores. Black said that the participants did not seem to him to be from the top academic echelon and that they were not very well able to stand the pace of the college-level courses.

Thus, the late recruiting start for the second summer's program resulted in qualified high school seniors being unavailable and there was a significant difference between the participant populations of the two summers. During the first summer, the students were predominantly high school seniors who had already qualified for college acceptance and who were motivated by the opportunity to sharpen their college-required skills. The second summer's participants were mostly a year younger, had completed fewer science and math courses, were not necessarily college-bound, and were, therefore, not as strongly motivated since potential benefits were more remote.

Management

During both of the project's two summer operations, the lines of management were not entirely clear to the instructional staff. In Kidd's proposal, he is named as Project Director on the cover sheet and his is the only resume included, though it does not seem likely that, as college president, he was planning to devote energies to full-time project direction. Because of the delayed funding, Clyde Williams was a late choice for the job of project coordinator, but his role was unclear to at least one of the instructors who referred to Nabih as the "project director in name" and omitted mention of Williams during the interview. From the interview with Williams, it appears that there was a division of responsibility between himself and Nabih, with Nabih overseeing the day-to-day operations and Williams participating in the planning, scheduling, and budgeting. Kidd's primary activity in the management of the program was to oversee the planning and make sure that the project bills were paid. The latter was a more complex process than usual because of the complicated system of expense justification and approval established by the Chicago College system. It frequently took a long time for bills to be formally approved, but Kidd was able to arrange payment through his own imprest fund and obtain reimbursement from contract funds at a later date.

The somewhat indistinct lines of management responsibility during the first summer do not seem to have caused any serious problems for the program and project activities were carried out approximately as planned in the proposal. However, management problems during the second summer of operation caused much more of a difficulty. By the beginning of the summer, Kidd was focusing on his potential new job and had virtually nothing to do with the project. George Hansberry, Kidd's successor as project director/coordinator, had come to Olive-Harvey on a conditional basis pending his final decision about relocating to the Chicago area. He had committed himself to stay at Olive-Harvey at least through the summer program of 1975 but, by the time the program started, he had already decided to leave and he submitted his resignation in July. Willie Black relates that he felt the program to be drifting when he agreed to teach the math section and says that he felt compelled to step in and take an active role in directing the project. He said that Hansberry seemed relieved to have him there since recruiting was well behind schedule.

Project activities began on June 23. A week later Kidd began his terminal leave and Homer Franklin, the vice-president, became acting president. Hansberry reports that the project's financial problems began immediately at the beginning of the summer when they tried to order books from the campus book store. The cost of the books was a budgeted project expense but it took three weeks to get the disbursement approved. The book store would not issue books to the participants until they were paid for. Further difficulties were experienced with the issuance of checks to cover speaker's fees for the engineers invited to give seminars during the summer program. Budgeted travel funds never were expended because plans were not approved in time to take the trips. John Sims, the physics instructor, told the AIR Study Director of his frustration at having long-anticipated field trips repeatedly canceled at the last minute.

Hansberry's difficulties were compounded when Franklin went on vacation and, at about the same time, the Olive-Harvey comptroller also went on leave. Hansberry says that during most of the summer the college was operated by a series of acting deans who could not or would not take the responsibility to approve vouchers. Further, none of the individual difficulties which were ultimately resolved seemed to set any precedent for the resolution of similar problems later in the summer.

Programming Activities

During the first summer of the project, the participants engaged in activities which were primarily academic and included instruction in algebra, biology, physics, and chemistry. In addition, small group and individual tutorial assistance was given during daily "laboratory" sessions which concentrated on problem-solving, reading improvement, and development of study skills. There were also presentations from guest minority engineers representing educational institutions and minority engineering firms plus at least three trips off-campus to sites of engineering interest. Altogether, there seems to have been a coordinated program of instructional and support services designed to provide the students with positive experiences with, and the academic preparation for, the content of engineering.

During the second summer institute, the academic program was essentially the same, though, as explained elsewhere, the field trips were omitted. A major difference between the two summer institutes was that the academic portion of the first was taught with the intent of providing a graded approach to learning (i.e., it was the intent that basic skills be mastered before progression to the more complex portions of the subject matter). While that plan was not completely carried out, there is no evidence that it even existed during the second summer. The apparent loss of an instructional philosophy coupled with the greater youth and consequent lack of experience of the participants during the second summer resulted in a generally disappointing outcome.

Program Evaluation

No objective impact evaluation was originally planned for this project, though an evaluation attempt was carried out with the second summer's programming. In the proposal it is stated that "the success of the Institute will be measured through joint meetings of the project staff and the advisory board." Three "criteria" of success were then listed, but each statement was really a sort of hypothesis, since no methodology was advanced for establishing whether or not the proposed "criteria" had been achieved. Further, there is no attempt to establish a controls which would allow outcomes to be ascribed unequivocally to project inputs.

In any case, even the judgements of success outlined in the proposal appear never to have been made. The brief report which summarized the first summer's activities says nothing about student attrition (which was hypothesized to be "nil"), academic performance (which was hypothesized to be "above average," though it was not made clear whether each student's performance was expected to be above average or whether the expectation was for the group as a whole), or participant interest in engineering as a career field (which was hypothesized to show a "significant increase").

The only indicator of success shown in the report of the first Summer Institute was a list showing the status of the participants three months after they had completed the summer training program. Ten of the 18 participants were enrolled in various engineering programs while an eleventh was in a liberal arts program. Two others were still in high school, and five had completed high school and were working. There was no indication in the report, or from the interviews which were conducted on-site, how many of the participants had been planning studies in engineering before enrolling in the Summer Institute, but at least a few of the participants had been recruited from among those who had been accepted at Olive-Harvey for its regular pre-engineering program.

The weakness of the original evaluation component was recognized by Willie Black and others who were involved in the 1975 Summer Institute. Plans were made to administer the Armed Services Vocational Ability Battery (ASVAB) as both a pretest and a posttest, and the CEEB Self-Scoring English and Math Placement tests as diagnostic measures. The ASVAB was to be used as an indicator that learning had taken place over the course of the summer, but by the time posttesting should have occurred, the Navy (who had administered the tests) had lost the pretests and were never able to locate them.

A second attempt at gathering evaluation information was more successfully carried out. In late November of 1975, a questionnaire was sent to each of the 20 students who were considered to have completed that summer's program. (The actual number of participants during the summer of 1975 is not definitively stated in any of the project documents. The longest class list shows 25 people enrolled in the biology course, but only 18 people are listed for the math course and 20 for the physics course. AIR was not able to obtain a class list for the chemistry course.) Through follow-up mailings and phone calls, responses were obtained from all 20. None of the four who had graduated from high school were attending an engineering school, though 13 students said that their experience at the Summer Institute had given them an incentive to pursue engineering as a career. It is difficult to interpret this latter response in light of the fact that all but four of the participants had the presumably negative experience of having failed at least one of the courses they took during the summer, and more than half of the participants failed all of their subjects.

There was no attempt to follow up the second year progress of those who had participated in the 1974 Summer Institute.

Summary Comments

With this project, as with others, the success of the techniques being experimented with was obscured by the absence of any real program of evaluation. The project experienced further problems, especially during the second summer of its operation, as a result of its shifting leadership and the consequent loss of single-minded focus on the project's original objectives and methodology. On the basis of the information in hand, it cannot be known for sure, but it does seem likely that an unanticipated result of the second summer's experience may have been the discouragement of potentially interested students from entering the field of engineering. Many students may have concluded from their failure at the special pre-engineering courses that the study of engineering was beyond their abilities.

16. CASE STUDY--THE UNIVERSITY OF MASSACHUSETTS

"Identification of Ethnic Minority Students for Science and Engineering"

May 15, 1974--August 31, 1975

Original Brief Description

The School of Engineering of the University of Massachusetts will carry out an experimental project to identify, counsel, and prepare a group of minority students for college entrance. Fifty students currently enrolled in the 12th year in vocational schools in the New England area, who have the basic math and science skills to succeed in college will be identified. The experimental group will be worked with extensively to enhance and stimulate their interest and potential so they will ultimately complete their program of study.

The project staff and the staff of the School of Engineering, University of Massachusetts, will design and develop engineering aptitude tests and interview procedures so that the potential ability of the students can be measured without the socio-economic and cultural biases inherent in present qualification tests. Once the group of student participants has been selected, the staff will establish group sessions at regular intervals to orient and assess the students. The goal is to have 14 or more of these students enrolled in the School of Engineering in the fall of 1975.

This experimental project will test the premise that there exists a large untapped source of potential ethnic minority students who can be considered for careers in science. These students are presently enrolled in non-science or vocational high schools whose course of instruction does not prepare them for entrance into traditional 4-year engineering colleges.

In addition to the above, it is expected that a group of vocational schools will be identified which will be willing to modify their programs to facilitate the early identification of minorities. These program adjustments will necessarily be developed with the help and support of the project staff. Future developments in this direction will require some form of financial assistance directly to the schools involved.

This project is unique among the 11 funded by the National Science Foundation in that it has attempted to redirect the interests of students already well-committed to non-academic science pursuits toward an academic engineering program, thus enlarging the pool of potential engineers from outside the pool of potential scientists. The technique identified able but scientifically unqualified candidates, established desirable and obtainable incentives, and coupled those with a careful testing of the level of motivation. Near-term behavioral indices show a very strong commitment to engineering study on the part of nearly all of the participants.

Project Personnel

Administrative Staff:

Melton Miller*	Principal Investigator Dean of the School of Engineering University of Massachusetts
Gilbert Lopez	Project Director Business Manager School of Education University of Massachusetts
Kenneth Smikle	Associate Project Director
Archer Dong	Program Assistant

Instructional Staff:

Wilfred Bancroft	Instructor Alexander Hamilton Vocational and Technical High School Brooklyn, New York
Myles Gaffney	Instructor Putnam Vocational-Technical High School Springfield, Massachusetts

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*Individuals whose names are underlined have been interviewed.

Leo Gusman	Instructor Samuel Gompers Vocational and Technical High School Bronx, New York
Arnie Levine	Instructor Chelsea Vocational High School Manhattan, New York
Joseph Nessing	Instructor A. I. Prince Vocational-Technical High School Hartford, Connecticut
Irving Tepper	Instructor George Westinghouse Vocational and Technical High School Brooklyn, New York
Stephen Tricamo	Instructor East New York Vocational and Technical High School Brooklyn, New York
Joseph Tuzzoli	Instructor Bullard - Havens Vocational-Technical High School Bridgeport, Connecticut

Participants: There were 37 participants in this program of whom 18 were accepted at the University of Massachusetts School of Engineering. Eight of those 18 were interviewed at length. Of the other 19, all had been high school seniors during the project, and by the time of the site visit, had dispersed to various colleges and universities or were otherwise not available for interview.

Associated Non-Project Personnel:

Clifford Flint	Assistant Principal Putnam Vocational-Technical High School Springfield, Massachusetts
Vincent Troianno	Career Education Office of the New York City Public School System
Manuel Munice	Director Trade and Technical Schools New York City Public Schools
Edward Miller	Acting Principal Alexander Hamilton Vocational and Technical High School Brooklyn, New York

The Context

The University of Massachusetts began active recruiting of minority students in 1967. Since that time, about 3,000 Black students have studied various fields at the University but only 10 have gone through the engineering program. In partial response to that situation, the Engineering Department has, for several years, operated summer institutes for high school students in grades 10 and 11. These students come to the university for three weeks during the summer and participate in an orientation and mini-courses which are funded by local industry. The popularity of the summer institutes has grown and the Engineering Department receives about 200 applications for the 75 available places. Gilbert Lopez, who is of Puerto Rican background and who had been an engineer for 15 years before coming to the University of Massachusetts, noticed that while the hispanic student population at the University was growing, there were very few people of Spanish background in the summer institutes. He brought this fact to the attention of the Engineering Department which admitted the deficiency and asked Lopez if he could help them program for Spanish background students.

The Engineering Department had already developed a very flexible freshman program as part of an overall effort to make engineering accessible to more people. This new program allowed first-year students with less than complete preparation in high school the opportunity to take pre-university level courses so that they could bring their skills up to par. Another element of the freshman programming was a modularized pre-engineering course which was taught in two-week segments by representatives of the various engineering disciplines so that students could get a taste of the different kinds of subject matter without having to commit themselves in any particular direction at the outset. As part of its programming for students with marginal backgrounds, the Engineering Department had established special aids which included both close supervision and tutoring.

Project Milestones

Lopez felt that the regular high schools were being well-mined for their capable minority students and was convinced that the best way to expand the pool of potential engineers was to work with the technical high schools. Project development began in early January of 1974.

1974

Early January	Lopez learns of the Minorities in Science programming through a chance acquisition of the NSF brochure.
Early January	Lopez writes a six-page prospectus and telephones NSF to see if his idea is of the sort NSF will support. He is encouraged to visit NSF to discuss his project idea.
Late January	Lopez visits NSF, has a detailed discussion of his program ideas, and obtains valuable feedback from the NSF staff.
Late February	A full proposal is submitted to NSF, but a telephone call from them requests some revisions.
March 8	Revised final proposal is submitted.
March 15 and 16	The NSF review panel meets to consider all of the proposals NSF has received in this funding category. Approval is recommended for the University of Massachusetts project.
Late April	Lopez, needing to begin making arrangements with the high schools before the summer vacation, calls NSF to inquire about funding decisions. He is told that no announcements have yet been made.
Late April	Lopez contacts the congressman from the local district who reports that his office has received a grant announcement from NSF saying that the University of Massachusetts project has been funded at its requested level.
May 22	Letter of award sent by NSF to Dr. Robert C. Wood, President, University of Massachusetts System at his office in Boston. It is not immediately forwarded to the Engineering School at Amherst.
June	Lopez begins visits to the education super-structure in both Boston and Springfield to elicit cooperation for the project.

1974

Mid-June	Lopez locates the grant award letter which had still not reached him through regular channels.
Late June	Project account is established.
Late June	Availability of project positions are advertised.
Late August	Kenneth Smikle appointed as Associate Project Director.
September 1	Smikle begins work with project.
September 6	Archer Dong begins work with project.
Early October	Boston schools are dropped as a potential participating organization as their integration problems multiply. Connecticut schools are immediately substituted.
Early Winter	Arrangements are completed with eight schools in New York City, Massachusetts, and Connecticut.
Mid-Winter	All teaching staff selected.
December	Student participants selected.

1975

Mid-January	Organizational meetings with student participants and their parents.
January 30 and 31	Participants and instructors are brought to the University of Massachusetts for a two-day orientation and introductory seminar.
Mid-March	Instruction phase is complete.
Early May	Construction phase is complete and students' final reports are submitted.
Late May	Those participants are selected who will attend the School of Engineering at the University of Massachusetts.

Critical Steps

Quality of Program Definition

The goals of the University of Massachusetts Project were made quite clear in the proposal: "First . . . *locate* minority students with an interest (in engineering). Second . . . *identify* those who have the *potential* to succeed in an engineering program. Third . . . *stimulate* and *enhance* the interest and potential of those students so that they will ultimately complete their program of study." The operational plans for achieving those goals were also well delineated, but not always fully communicated to the individual high schools and the cooperating instructors located there. Several of the instructors were unclear about how the students at their schools had been chosen and felt that they should have had the opportunity to participate in that selection. Moreover, the criteria for student selection was, in a few cases, not made clear to the high school administrative staff who carried out the task. At some schools, the top students were excluded from consideration because they would have an excellent opportunity to attend college without the assistance of the project. At other schools, the academically best-qualified students were identified for inclusion since they had the best chance at what was interpreted as a competitive scholarship program. While these differences in the guidelines for identifying potential participants did not have any identifiable negative impact on the project, they did create some resentment at those schools which saw less well-qualified students (from the traditional academic point of view) being selected over those who were "more deserving."

Program Planning

The steps by which the project goals were to be approached were made clear to all concerned--the instructors as well as the participants--by utilizing the mechanism of the two-day orientation session at the Amherst campus of the University. While there, the instructors were given a complete and detailed explanation of the program, had all of their questions answered, and then observed while project administrative personnel taught the first few portions of the program to the student-participants.

Once sessions at the individual high schools began, Archer Dong or Ken Smikle were scheduled to visit each school once a week in order to resolve problems and answer questions. As things worked out, other demands prevented visitations on the original one-week schedule, but the less frequent schedule coupled with the easy availability of project staff by telephone allowed the instructors at the high schools to feel that their needs for contact and information were being met.

No formal evaluation was planned. The success of the project was to be determined by the number of students who were accepted for admission by the School of Engineering. As an additional indicator of success, it was planned to compare the project participants' basic science and math skills with those of other university students accepted through the regular admissions process. On one hand, these after-the-fact indicators make sense because the expected engineering school enrollment of technical high school graduates was zero, and any who could be enrolled through project participation would represent a substantial increase in the number of minority students at the School of Engineering. On the other hand, the "measure" is severely biased, since the project emanates from the School of Engineering which could be expected to have more than passing interest in the project's success. Happily, the evaluation activities of the project were far more varied than originally proposed.

Staff Selection

The requirements for the three core staff positions were for people with an engineering background or an expertise in mathematics and who were mature enough to carry out what were expected to be rather delicate negotiations with the high school teacher super-structure. It was also seen as vitally important that the core staff be members of minority groups. Ken Smikle is Black with extensive experience working at engineering companies in personnel and managerial positions. He does not have an engineering degree, but at the time of his hiring for the project was enrolled at the University of Massachusetts in a master's degree program in engineering management. Archer Dong is Asian with both an electrical engineering and a high school teaching background which included four years at an all-Black high school in New York City. He had decided to take a leave of absence from teaching to get his doctorate in education and was attracted to the project because the half-time position carried with it free tuition for several courses a year. Since Gil Lopez' background also included a strong familiarity with the New York City Schools and their organization, and since Smikle and Dong were immediately recognized to be very strong and energetic workers, the decision was made not to hire a third assistant and the budget allocation for that position was later allowed to be used for other purposes.

Considerable effort was made in the selection of the high school instructors who would teach the project participants. It was explained to each cooperating school principal that the local monitor had to have a strong math background and a demonstrated empathy for the students. This local monitor would act as an extension of the project staff and would work very closely with the project. At a few of the schools these requirements were met by only a single individual, but at most of the institutions more than one alternative was named. In each case, Smikle or Dong visited the classrooms of the nominated instructors to see whether they had good control over their class. Each prospective instructor was then interviewed for about an hour during which the instructor's racial attitudes were challenged by stressing the minority aspects of the program. (It is not known how many of the prospective instructors were themselves from minority groups, but there was only one among the eight finally chosen.) Two additional points were stressed with the prospective instructors: participation would require a considerable amount of their after-school time--two hours a day, three or four days a week for about three months--but the rewards might also be great, since the instructors would have the opportunity to work very closely with a handful of students over a fairly long period of time and, if the program was successful, it could have a strong positive impact on the school. The instructors were to be paid a nominal sum for their extra time in school, but the project was really relying on the instructors' professionalism and their interest in the students.

Participant Selection

The basic premise for the project was that there exists a large untapped pool of minority students who are potentially capable of pursuing college careers in engineering but who are enrolled in vocational high schools primarily because of socio-economic factors beyond their control. Even though they may not have had the opportunity to acquire the requisite mathematics and science background, they do have the aptitude to succeed in a college engineering program. In New York City, vocational schools have an open enrollment, so those with a high minority population relative to the population in the immediate vicinity of the school would be more likely to be the better schools and thus would be expected to include a relatively higher proportion of students who have the ability to attend regular high schools in college preparatory courses, but who couldn't afford to do that or had not been prepared to do that.

The original hope had been that arrangements could be made with vocational schools in Boston, Holyoke and Springfield in western Massachusetts, and in New York City. But Holyoke showed little interest and negotiations with Boston continued for some time before they, too, were broken off, primarily as a result of the just-promulgated integration order which was disturbing the city. When it became apparent that negotiations with Boston would be protracted, contacts had been made with the Superintendent of Schools for the state of Connecticut. Vocational schools in Bridgeport and Hartford joined the project when arrangements with Boston could not be concluded in a timely fashion.

In New York City, four vocational high schools had been identified by Lopez as possible participants. Two additional schools were suggested by George Quarrels, the Director of the Career Education Office of the New York City Public School System. One of the schools declined, but the other five elected to participate.

Considerations of class size, the expected dropout of some of the participants, and the number of special students which the University of Massachusetts School of Engineering could accept meant that eight to 10 students would be chosen at each of the eight participating high schools (five in New York City, Bridgeport, Hartford, and Springfield).

The schools were asked to identify those students who had ability or potential in mathematics and to consider especially those students who had

had disciplinary problems in the classroom due to boredom or lack of challenge. Then Lopez, Smikle, and Dong (the core staff) visited each school where they brought the nominees together for a meeting to discuss Careers in Engineering. Emphasis was placed on the extended period of hard work which was necessary in order to become an engineer and minority-oriented printed materials were handed out. Later, each student was interviewed and then discussions were held with the nominating teacher. Parent involvement was solicited and each student had to return an acknowledgement from his or her parents that the parents had read the printed material which described the project.

About 200 students were interviewed and evaluated on their maturity, their ability to deal with change, and indications of their drive. From the 200, 57 participants were selected, of whom about half were Black and half Hispanic with one Asian student and one White student.

Following student selection, group meetings were held in New York City and in the other cities for the participating students and their parents. There, the purposes of the program were again explained, the need for hard work and perseverance on the part of the students and support on the part of their parents was underscored, and the potential benefits were enumerated.

The incentives from the students' point of view were extremely strong. Each knew that about 50 participants were to be selected and that the Engineering School of the University of Massachusetts was keeping at least 15 places open for those who successfully completed the project. In addition, the participants had been told that financing would be made available to them. Thus, it was clear to each participant that a strong effort over a period of about three months could very well lead to the opportunity to pursue a college degree with most expenses paid; something which nearly all of the participants had believed to be beyond their reach.

Programming Activities

The first activity of the project was the visit of the 57 participants and eight instructors to the University of Massachusetts for a two-day orientation session. Buses were hired in New York City and Connecticut which picked up the students at their respective high schools for the trip to Amherst. During the two-day period, the students attended the first few classes of the special project instruction, were given demonstrations in the engineering laboratories, met with groups of engineering students, lived in the dorm, and ate in the student dining room.

The trip turned out to be a tremendous motivating factor. One of the instructors described it as "electrifying to the students--it absolutely changed the students from moderate interest to avid interest." Another instructor described the campus visit as one of the most important parts of the program and pointed out that it "gave them a tangible, realistic experience as a goal . . . when they came back they were ready to go and they would have done anything." Most of the other instructors also reported dramatic increases in student motivation as a direct result of the visit.

Activities at the individual high schools began about two weeks later, after a visit schedule had been set up for Dong and Smikle. Most of the classes were held after school, though at one location, program activities were conducted for an hour before school and for a second hour during the lunch period due to job involvement of several of the participants. The 60 class-hours of project work was termed the "Math Aptitude Program," (MAP) and had a project-oriented format consistent with the type of learning experience the vocational high school student is familiar with.

The original idea for the MAP was to require the student to design, build, and evaluate the performance of a physical device to given specifications. The criterion of familiarity of that device to all students was deemed to be essential in order to avoid the problems which might have resulted if some students had prior knowledge of the device and others had none. In addition, familiarity was expected to arouse innate curiosity and provide a base for intellectual reinforcement of what the student knew about the device informally. In the search for an appropriate construction task, nine other criteria were used, including economy, safety, ease of construction by a single student, and a complexity great enough to allow flexibility in applying mathematical principles so that student abilities could be differentiated. A number of common items were considered before the radio was selected as meeting all of the criteria best.

The objective of the Math Aptitude Program was to assess the vocational high school student's math aptitude by having the student build a radio device, the construction and performance of which is based on fundamental mathematical principles. It was assumed that the student's ability to apply mathematical skills to a practical project would be an indicator of the student's interest in pursuing a technical career.

The first phase of the MAP (approximately 30 hours) was quasi-instructional in order to give the students some basic concept of the operation of a simple AM radio. Material presented during this phase was designed to enhance and reinforce the student's existing mathematical ability rather than to teach new concepts. The purpose was to determine whether or not the student had conceptualized the algebraic process sufficiently to be able to apply that knowledge to new learning situations.

The second half of the MAP was the construction phase and called for the student to design and build a capacitor element to replace one which had been removed from the radio kit which the student had previously built. Each student was assigned a particular radio frequency, and was expected to apply basic mathematical skills to the design and construction of the missing capacitor. During this phase, the instructor was cautioned not to assist the students with the actual work on the capacitor, but to act only as a resource to guide the student to information the student determined was necessary before the capacitor could be constructed.

During the course of the MAP, the student was given a series of traditional short written tests after the completion of specific learning increments to determine his or her grasp and understanding of the material which had been presented. At the end of the program, a final test was given which was composed of two parts: a project report to be written by each student detailing the design and construction of the capacitor, and a traditional math test covering all of the mathematical concepts and principles dealt with in the MAP Program.

Discussions with the project instructors revealed that virtually all of the participants worked with considerable determination and resourcefulness, and it was also reported that the results of those participants who had caused disciplinary problems during their regular schooling had been among the best of the group.

Program Evaluation

A planned summative evaluation of this program is still incomplete as of this writing, but there are numerous indicators of project success. Of the original 57 participants, 15 dropped out of the program during the first few weeks, apparently after deciding for themselves that their interest in engineering was not strong enough to be worth the effort it was then apparent would be necessary. Five others dropped out for other reasons, such as the need to earn after-school money to help with family support. Of the 37 participants who persisted to the end of the project, 18 were admitted to the University of Massachusetts. Of the 19 who were not, the present activities of six are not known, but nine have been admitted to engineering programs at other institutions of higher education. Thus, 27 of the 31 participants who were successfully followed-up have committed themselves to the study of engineering.

Reports from the instructors, supported by interview responses of participants who are attending the University of Massachusetts, suggest that prior to program involvement only a handful of the participants had any plans to continue formal education past high school. (Most of the participants were well-known to their respective project instructors prior to the project.) Archer Dong, who worked closely with the participants from New York City and who had had a great deal of experience teaching students very much like those involved in the project, estimated that had the project not intervened, one or two of the participants would probably have gone on to four-year colleges and that several more would have gone to community colleges. He pointed out that, very likely, a large proportion of the latter would have dropped out within a year.

In addition to these indicators of the substantially increased commitment of project participants to engineering education, there are also success indicators at the project's associated institutions. For example, at the University of Massachusetts, the costs for an out-of-state student, whose numbers are limited to 5% of the student body, are approximately triple the costs for a student from Massachusetts and, as things worked out, 15 of the 18 who were admitted to the engineering program through this project came from Connecticut and New York City. Thus, the University committed financial assistance resources to the project which could have been used for a somewhat larger number of in-state applicants.

Other educator's judgements about the program have taken the form of policy decisions. One school's experience was so positive, the principal was prompted to write:

> We will move heaven and earth to preserve this vital course offering ... . (but if funds for a full program are not available) . . . our school intends to offer pre-engineering orientation to every class of seniors in the future whether we receive support from external sources or not . . . we will do everything in our power in future years to get a direct grant from the federal and/or state government through the New York City District. We would also make any adjustment necessary from tax levy funds to permit the course to go into operation.

The director of Bullard-Havens Regional Vocational-Technical School suggested in writing that the Connecticut central office should consider incorporating the program throughout the 16-school Connecticut vocational system.

At other participating high schools, both solicited and unsolicited remarks from principals testified to positive effects beyond the students' immediate project activities. A frequent comment concerned the raising of aspiration and interest levels of other students, particularly minority students, as a result of the incentives demonstrated by the project. A general rise in grades, especially in mathematics, was often noted among the participants.

Vincent Troianno, of the Career Education Office of the New York City public school system, pointed out that though the University of Massachusetts project was one of over 100 being conducted in City schools, its success at stimulating both students and teachers prompted the school system to agree to contribute funds for a projected second effort of the program. Troianno said further that the Career Education Office has seriously been considering institutionalizing the operation and expanding it into many more schools.

The first-year success of the 18 participants who were admitted to the University of Massachusetts has not yet been fully documented as of this writing. However, there was no attrition among them during their first year and all returned to the University in the fall of 1976. Six of the 18 have thus far achieved "outstanding" records. While these students were sheltered to some degree from the usual rigors of the freshman engineering program during their first semester, they attended regular freshman classes in mathematics, science, and engineering courses during the second, and their overall performance is considered by the school to be just as good as that of students admitted through the usual selection procedures.

Summary Comment

The University of Massachusetts has apparently been successful at combining the existing resources of vocational high schools and an engineering school in an innovative fashion which is capable of identifying potential engineering students with ability but without the usual formal credentials for engineering school entrance. The project has been characterized by unusually careful planning and uncompromised criteria for the selection of both instructional staff and student participants. Support from the parent institution was impressive, and excellent working relationships were established between the University and the several participating high schools.

Section III

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17. TYPICAL EDUCATION FLOW PATTERNS

Introduction

In order to provide a context for the NSF-funded minority projects and their potential impact on the science education of minority students, it seemed necessary to gain an overall picture of the typical education flow pattern for each of the minority groups involved. The result is the series of "Typical Education Flow Pattern" diagrams included in this chapter.

The data has been assembled from a very large variety of sources. The intent has been to provide a picture of the education experience of the various subgroups as it now exists because that is the basis on which intervention attempts will have to be made. The diagrams do not represent the experience of any single cohort as it passes through the various stages of education; rather, they display the best information available for each stage, even though that information may be based on data collected a year or two earlier or later than the data for the next stage. In many cases, the information presented has been adjusted so that it does not conform exactly to available published data. That adjustment is of two types: When data from two or more sources was inconsistent, the figure in the diagram represents a judgement based on the relative recency of the sources and the methodology of the original data collection; when the best available data is relatively old, the figure presented in the diagram has been adjusted to conform more closely to recent experience even though the latter may be narrowly based or informally documented.

In spite of the fact that the education flow figures necessarily are only close approximations, the set of diagrams is a useful tool for a number of applications:

--Relative educational experience can be compared easily both longitudinally from step to step within the education process, and across ethnic groups. Points of divergence are readily identified and the areas of greatest need become immediately apparent.

--The cumulative experience (such as the number of college graduates as a proportion of the entering freshman class) can be determined quickly by entering the diagram at any point with an assumed base of 100 and then multiplying by the percentages found in the succeeding boxes up to the education level which is of interest.

--The diagrams can be used to yield a rough gauge of the relative cost-effectiveness of different types of approach. For example, an intervention strategy carried out at the high school level would have to demonstrate considerably greater effectiveness or cost considerably less per student than a strategy carried out during the freshman year at a four-year college in order to be equivalent in ultimate impact because of the normally high dropout between high school completion and the onset of post-secondary education. Moreover, with the different entry rates of minority groups to four-year institutions, a strategy which is cost-effective for one group may not be for another.

The figures, however, suggest a static quality which does not exist. There are several trends which have developed over just the past few years which make the representation of "typical" education experience a risky business. For example, about one out of every six students who enroll in a school of higher education has waited a year after completion of high school before doing so, and that figure is even larger for native American, Mexican American, and Puerto Rican students.

As colleges and universities have made their degree requirements less rigid, people who, in the past, might have dropped out and stayed out, now are finding ways of eventually returning to their education and obtaining baccalaureate degrees. The figures in the flow diagrams conform to the traditional pattern of a four- or five-year residence before receiving a degree, though the five-and ten-year follow-up study recently completed by El-Khawas and Bisconti suggests that 75% to 80% of college attendees earn a degree eventually.

The non-availability of data created some problems. There is little good national information regarding the retention rates from year to year within the four-year college or university, and that was expected since those figures are of most utility to the institutions themselves. However, it was surprising that indications of the rate of community college completion and rate of transfer to four-year institutions for the various minority groups were most difficult to find. To be sure, the issue is complicated by the relatively large number of part-time students who extend their enrollment past the two years normally required for an associate degree, but no recent minority cohort studies seem to exist. Of even greater surprise is the relative lack of data regarding graduate school enrollment in science/engineering fields. Quite complete summary information is available for full-time students as a group, but substantial numbers of graduate students attend part-time, and minority students may make up a disproportionate segment of the latter. Finally, though there are counts of science area PhD degrees granted to minority group members, there is very little information concerning the number of master's degrees granted, and it seems likely that minority students would be relatively better represented among those degree recipients than among PhD recipients.

A cautionary note must be added. The diagraming of the education flow in the present manner obscures some very important phenomena, e.g., the relatively large number of Mexican American and Puerto Rican students who are behind age-grade. Moreover, though the enlargement of the pool of potential science students has been the goal of several efforts, it has not been possible to track that subgroup through the education process. This is unfortunate since it is likely that the experience of those students differs considerably from that of students in general.

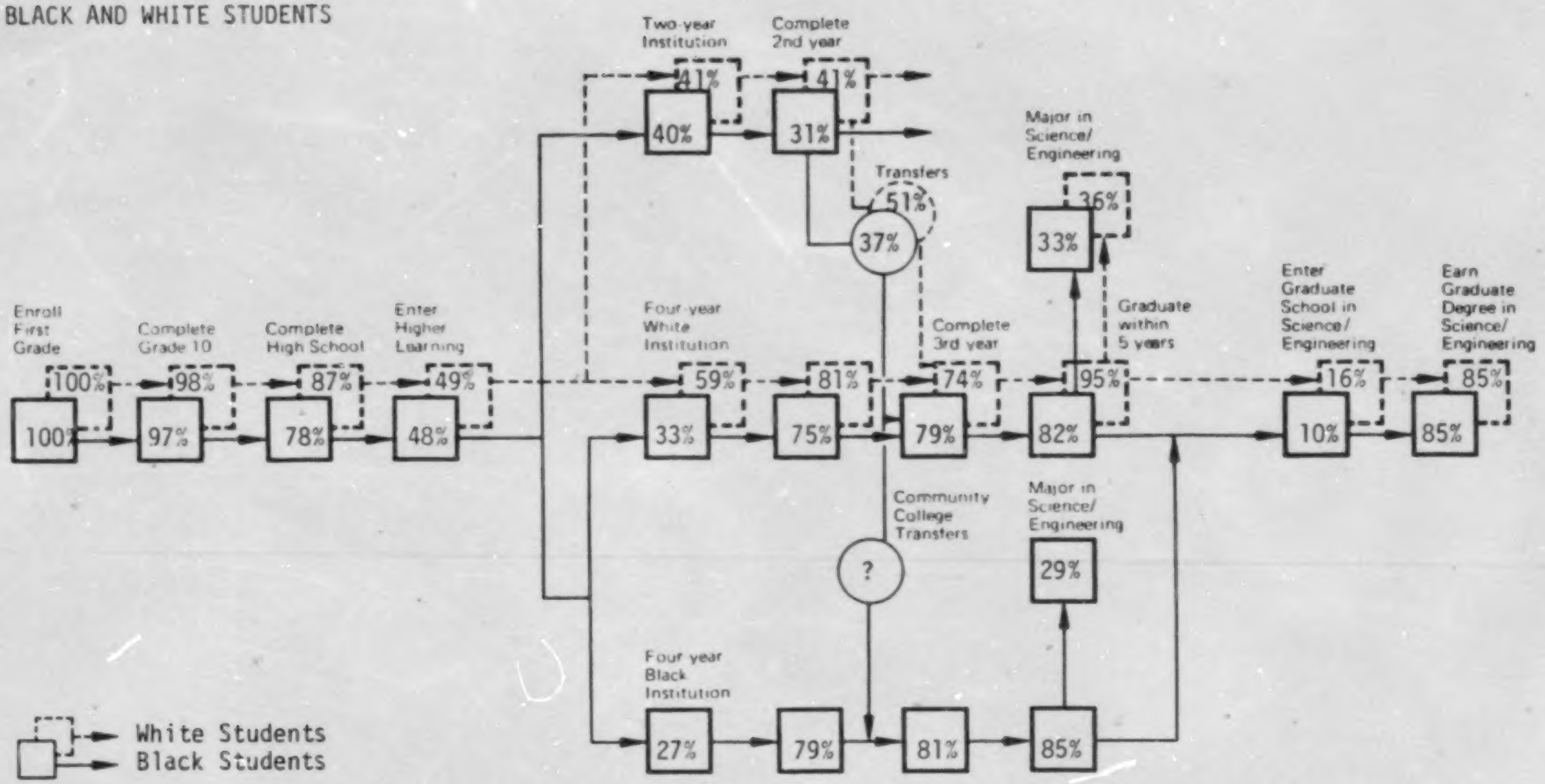
Minority Education Flow Patterns

Figure 1 shows the Typical Education Flow Pattern for Black students as compared to that of White students. The overall picture is one of a persistent decrement in retention at the various stages of education. There are no points of large-scale divergence, though there is still an important difference in the high school completion rate. The proportion of students who successfully complete two-year institutions and transfer to four-year institutions also appears to be somewhat less for Blacks than for Whites though these figures may contain a somewhat larger degree of error than most of the others due to the relative lack of data related to this issue.

The differences shown in Figure 1 cumulate as the education process unfolds. Of those students who enroll in first grade, 42% of Whites and 36% of Blacks enter higher learning at either two- or four-year institutions.

TYPICAL EDUCATION FLOW PATTERN:

BLACK AND WHITE STUDENTS


Enroll First Grade
100%
100%
Complete Grade 10
98%
97%
Complete High School
87%
78%
Enter Higher Learning
49%
48%
Two-year Institution
41%
40%
Complete 2nd year
41%
31%
Transfers
51%
37%
Major in Science/ Engineering
36%
33%
Four-year White Institution
59%
33%
81%
75%
Complete 3rd year
74%
79%
Graduate within 5 years
95%
82%
Enter Graduate School in Science/ Engineering
16%
10%
Earn Graduate Degree in Science/ Engineering
85%
85%
Community College Transfers
?
Major in Science/ Engineering
29%
Four year Black Institution
27%
79%
81%
85%
White Students
Black Students

NOTE Each figure represents the proportion of students from the previous stage who continue their studies

Figure 1.

Calculated on the same base, 14% of White students and 11% of Black students graduate from four-year colleges or universities and 5% of White first-graders earn a baccalaureate degree in a science field while only 3.5% of the Black youngsters do so. (All of the above figures can be found from the diagram by multiplying the proportions at each step shown.)

One final point should be made regarding the relatively low proportion of Black students who graduate from college/university after having completed their third year. As was alluded to above, many college students receive their bachelor degree beyond the traditional four-year time-frame. For economic reasons, this may well affect Black students more strongly than White students and, if so, that would account for some portion of the depressed graduation rate.

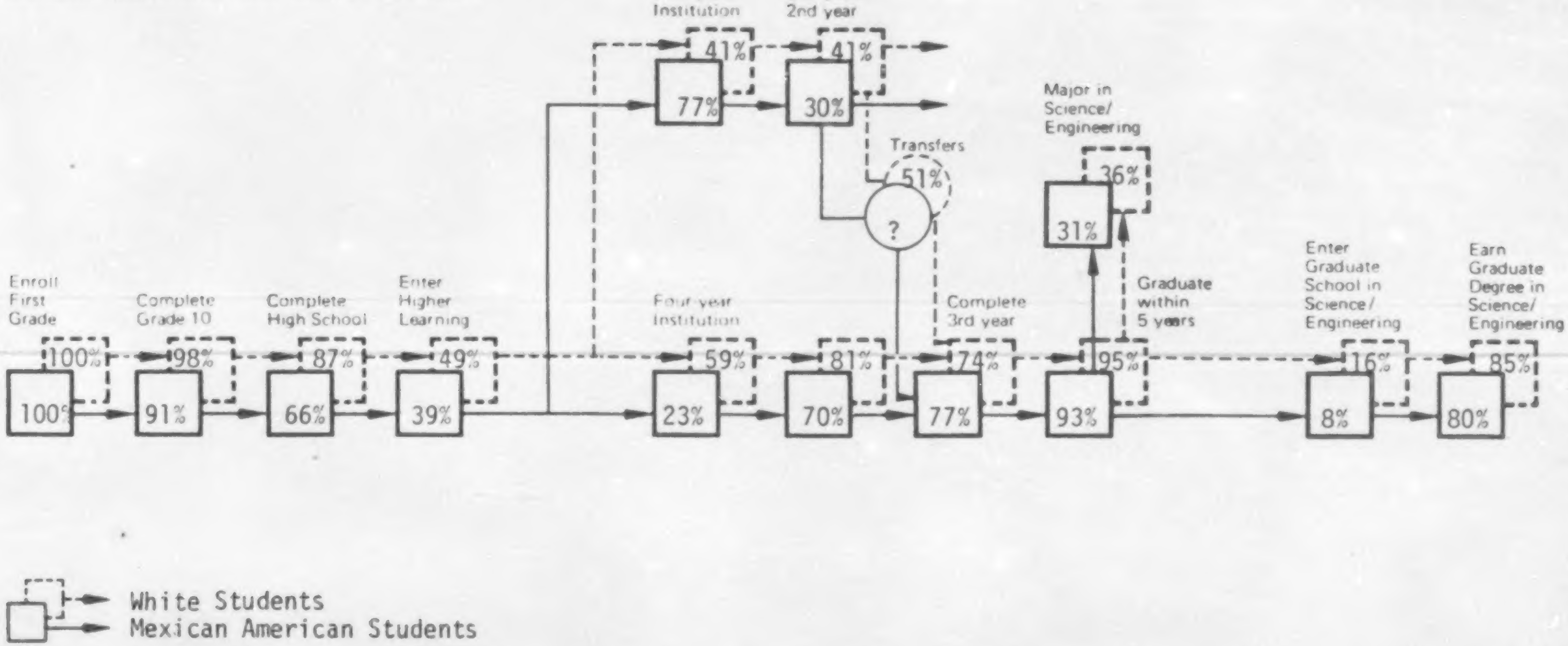
Figure 2 shows similar information for Mexican American students in comparison with White students. The overall pattern is one of fairly large-scale divergence from the experience of Whites until the point of entry to four-year institutions of higher learning where the differences persist but are generally of a smaller order except for the relatively high first-year dropout for Mexican American students. There are two points where the differences between Mexican American and White students are extraordinarily large: The proportion of Mexican American students who enter two-year institutions is nearly double that of White students; while of college/university graduates, only half the proportion of Mexican American students enter graduate school in science fields as do White students.

The cumulated educational experience of Mexican Americans reveals that of those who start first grade, 23% (vs. 42% for White students) enter higher learning, 3% (vs. 14%) graduate from four-year colleges or universities, and only 1% (vs. 5%) obtain baccalaureate degrees in science or engineering.

Figure 3, though incomplete, shows the education experience of Puerto Rican students as far as could be determined. Information acquisition was impeded by the fact that in statistical studies Puerto Ricans have been lumped together with Mexican Americans, Cubans, and others under the general rubric of "Spanish surname." There is obviously an immediate need to correct this problem so that education priorities can be set.

TYPICAL EDUCATION FLOW PATTERN:

MEXICAN AMERICAN AND WHITE STUDENTS

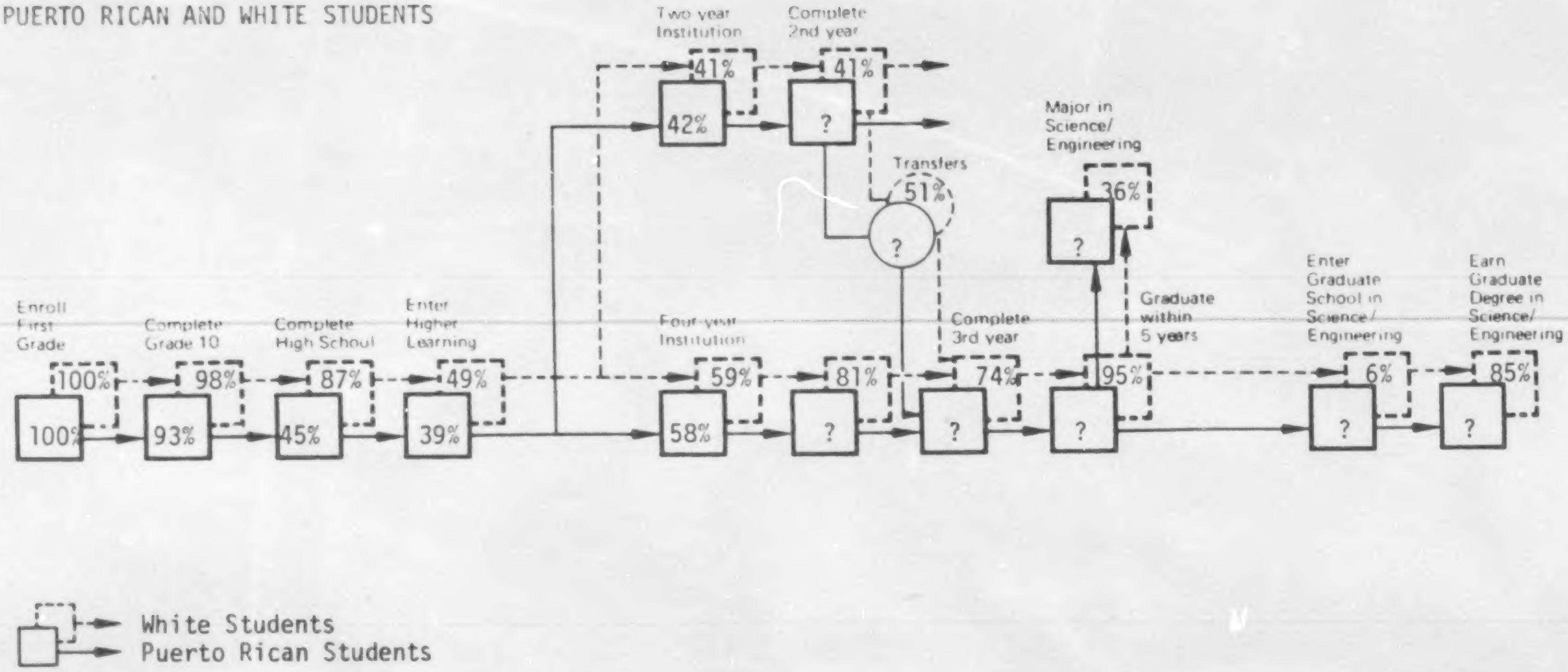

Enroll First Grade
100%
100%
Complete Grade 10
98%
91%
Complete High School
87%
66%
Enter Higher Learning
49%
39%
Two year Institution
41%
77%
Complete 2nd year
41%
30%
Transfers
51%
?
Four-year Institution
59%
23%
81%
70%
Complete 3rd year
74%
77%
Major in Science/ Engineering
36%
31%
Graduate within 5 years
95%
93%
Enter Graduate School in Science/ Engineering
16%
8%
Earn Graduate Degree in Science/ Engineering
85%
80%
White Students
Mexican American Students

NOTE Each figure represents the proportion of students from the previous stage who continue their studies.

Figure 2.

TYPICAL EDUCATION FLOW PATTERN:

PUERTO RICAN AND WHITE STUDENTS


Enroll First Grade
100%
100%
Complete Grade 10
98%
93%
Complete High School
87%
45%
Enter Higher Learning
49%
39%
Two year Institution
41%
42%
Complete 2nd year
41%
?
Transfers
51%
?
Four-year Institution
59%
58%
81%
?
Complete 3rd year
74%
?
Major in Science/ Engineering
36%
?
Graduate within 5 years
95%
?
Enter Graduate School in Science/ Engineering
6%
?
Earn Graduate Degree in Science/ Engineering
85%
?
White Students
Puerto Rican Students

NOTE Each figure represents the proportion of students from the previous stage who continue their studies

Figure 3.

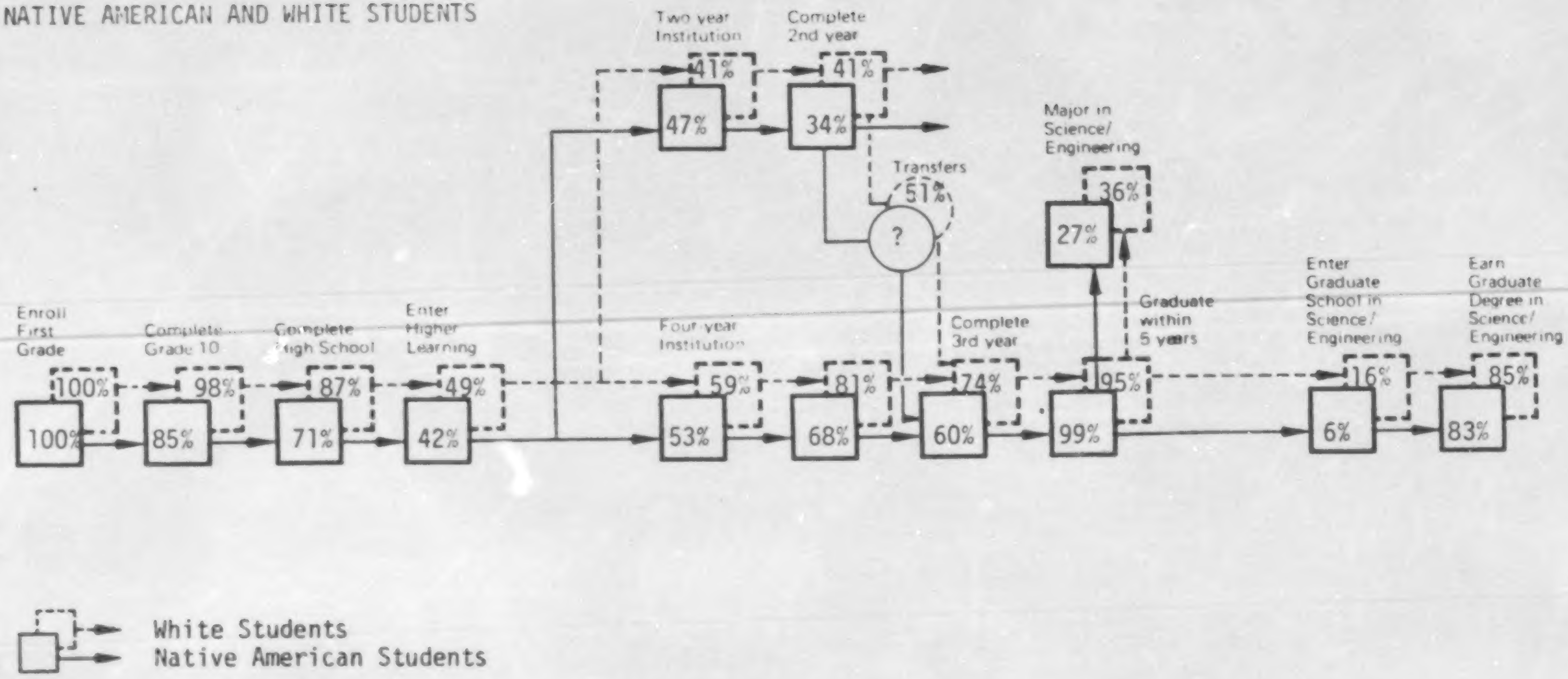
From the data which is available, it can be seen in Figure 3 that only about half as many Puerto Rican students complete high school as do White students, though of those who succeed, approximately equal proportions of Puerto Ricans and Whites enter two- and four-year institutions. It is important to note that Valdivieso, in his 1976 report concerning Puerto Rican high school dropouts, estimates that at high school age, as many as 25% of Puerto Rican students are a year or more behind their age-grade. This, of course, has a strong effect on the persistence figures collected at the usual points in the education process.

Much more complete data is available for native American students (Figure 4). The most comprehensive come from the Bureau of Indian Affairs (BIA), though only a minority of Indian students attend BIA schools. Surveys carried out by the Office of Education cover a different base population than do BIA surveys because of differences in the way the two organizations define "native American." BIA includes only those people who are on tribal roles, and therefore a relatively larger proportion of people living in rural areas; while the Office of Education definition includes anyone with a specified minimum proportion of Indian blood who self-identifies as an Indian, and thus incorporates many unaffiliated city-dwellers. As far as possible, these two major sources of information have been reconciled in Figure 4. It should also be pointed out that most of the information related to attendance at institutions of higher learning comes from the Bureau of Indian Affairs, which administers a scholarship program which provides at least some funding to the majority of native American students engaged in post-high school education.

The overall pattern in Figure 4 for native American students shows that their relative retention rates through high school are somewhat lower than for White students and that there is an even larger difference during the years of higher education. Of those who enter four-year institutions, 57% of White students ultimately graduate while only 40% of native American students do. These figures for native Americans are undoubtedly affected by their rather high dropout/drop-in rates, which must make it hard to determine who is enrolled and who is not.

TYPICAL
EDUCATION
FLOW PATTERN:

NATIVE AMERICAN AND WHITE STUDENTS


Enroll First Grade
100%
100%
Complete Grade 10
98%
85%
Complete High School
87%
71%
Enter Higher Learning
49%
42%
Two year Institution
41%
47%
Complete 2nd year
41%
34%
Transfers
51%
?
Four-year Institution
59%
53%
81%
68%
Complete 3rd year
74%
60%
Major in Science/ Engineering
36%
27%
Graduate within 5 years
95%
99%
Enter Graduate School in Science/ Engineering
16%
6%
Earn Graduate Degree in Science/ Engineering
85%
83%
White Students
Native American Students

NOTE Each figure represents the proportion of students from the previous stage who continue their studies

Figure 4.

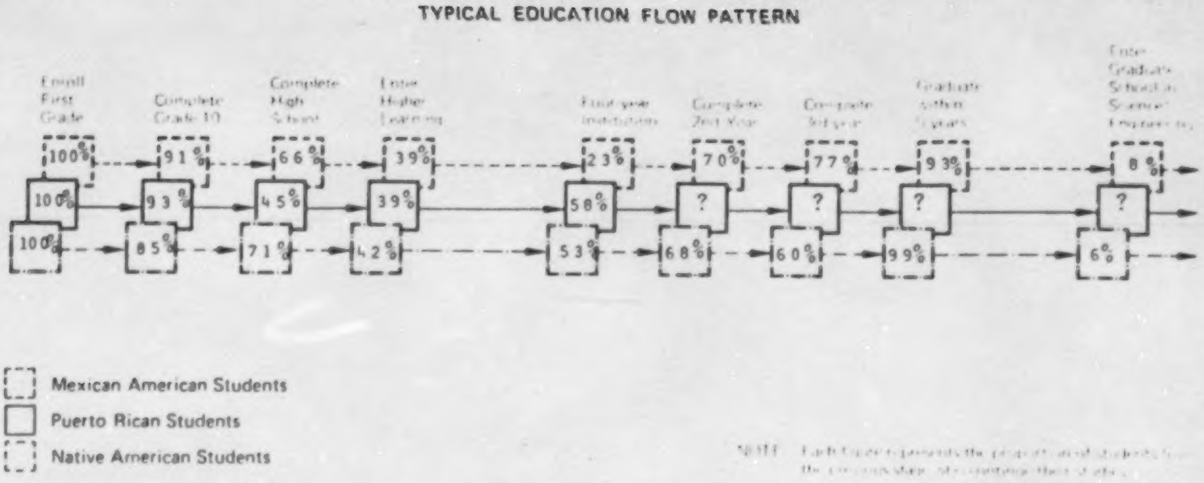

TYPICAL EDUCATION FLOW PATTERN
Enroll First Grade
Complete Grade 10
Complete High School
Enter Higher Learning
Four-year Institutions
Complete 2nd Year
Complete 3rd year
Graduate within years
Enter Graduate School in Science/Engineering
100%
91%
66%
39%
23%
70%
77%
93%
8%
100%
93%
45%
39%
58%
?
?
?
?
100%
85%
71%
42%
53%
68%
60%
99%
6%
Mexican American Students
Puerto Rican Students
Native American Students
NOTE

Figure 5

To complete the comparison, of those native Americans who enroll in first grade, 25% (vs. 42% for Whites) enter higher learning, 5% (vs. 14%) graduate from a four-year college or university, and 1.5% (vs. 5%) major in science or engineering.

The comparative education experience of the three less numerous minority groups is shown in Figure 5. Some of the major priorities are immediately evident: Compared with the other groups, many native American youngsters drop out of the education process prior to the completion of the tenth grade; among Puerto Rican students, the major drop in retention rate occurs at the point of high school completion (Mexican American students are also lost at a fairly high rate at that point); the three groups have approximately equal rates of entry into higher education after completion of high school but less than half as many Mexican Americans attend four-year institutions as do students from the other groups; and native American students have a large dropout rate during their years of higher education.

The priorities for Black students (Figure 1) are not as clear-cut. As already pointed out, Black retention rates approximate those of Whites at most points in the process and are somewhat greater than the other three minority groups. However, it is quite clear from the cumulated rates that there are still significant differences between the Black experience and the White experience in education. This is especially true when the number of those entering graduate training in science fields is considered.

Sources

Following are the major sources for the Typical Education Flow Pattern data included in this section. Many other sources are listed in the Bibliography included in Exhibit II.

Astin, A. W. *College dropouts: A national profile*. Washington, D. C.: American Council on Education, 1972.

Astin, A. W., King, M., & Richardson, G. T. *The American freshman: National norms for fall 1975*. Washington, D. C.: American Council on Education and UCLA, 1975.

Bayer, A. E. *The Black college freshman: Characteristics and recent trends* (ACE Research Report Vol. 7, No. 3). Washington, D. C.: American Council on Education, 1972.

El-Khawas, E. H., & Bisconti, A. S. *Five and ten years after college entry* (ACE Research Reports Vol. 9, No. 1). Washington, D. C.: American Council on Education, 1974.

ERIC Clearinghouse on Higher Education, The George Washington University. *Research currents*. Washington, D. C.: American Association for Higher Education, 1973, 1-2.

Federal Interagency Committee on Education (FICE). Task Force on Higher Education for Disadvantaged Minorities. *Task force report on higher education for Chicanos, Puerto Ricans, and American Indians*. Unpublished report, April 1973.

Holstrom, E., & Bisconti, A. *Transfers from junior to senior colleges* (revised final report). Washington, D. C.: American Council on Education, 1974.

The Indian Education Act of 1972, a brief history, analysis, issues and outlook. Washington, D. C.: CPI Associates, Inc. 1973, 62-65.

Minorities in engineering. Washington, D. C.: Committee on minorities in engineering, fall 1975, Vol. 1, No. 1.

National Board on Graduate Education. *Minority group participation in graduate education* (NBGE Report No. 5). Washington, D. C.: National Academy of Sciences, June 1976.

National Center for Education Statistics. *The condition of education; A statistical report on the condition of education in the United States, 1976 edition*. Washington, D. C.: U. S. Government Printing Office, 1976.

National Science Foundation. Graduate science education student support and post doctorals, fall 1973: Detailed statistical tables--Appendix III (NSF 74-318A). Washington, D. C.: 1974.

U. S. Commission on Civil Rights. The unfinished education: Outcomes for minorities in the five southwestern states (Mexican American Educational Series Report II). Washington, D. C.: U. S. Government Printing Office, 1972.

U. S. Department of Commerce, Bureau of the Census. Current population reports, population characteristics, school enrollment--social and economic characteristics of students: October 1974 (Series P-20, No. 286). Washington, D. C.: U. S. Government Printing Office, 1975, 9-10.

Valdivieso, R. Social factors in educational attainment among Puerto Ricans in U. S. metropolitan areas, 1970. New York: ASPIRA of America, June 1976.

18. RECENT MINORITY SCIENCE EDUCATION INTERVENTION ATTEMPTS

The 11 NSF-funded projects are, of course, only a few of the attempts made over the past few years to increase the participation of minority students in science. The Office of Opportunity in Science of the American Association for the Advancement of Science (AAAS) has just completed an inventory of those science education projects for minority students carried out from 1960 through 1975. While their report was in preparation, they allowed AIR to have access to their files and most of the information in this chapter is from that source. The approximately 400 projects which AAAS cataloged, while not all-inclusive, do represent a broad variety of attempts to improve science training of minority students.

Most of the projects were efforts to aid minority students already in colleges and universities, but nearly 100 of them dealt with the age groups of interest in this report, so to lend context to the NSF-funded efforts, these were abstracted and categorized by AIR. Table 1 presents a summary of that material. The programs are arranged in the table according to students' age group and by the length of student exposure to the program inputs. It is apparent from the table that a variety of different approaches have been tried, but very few of the programs have evaluated their own impact and not one longitudinal study is on the list (though several follow the students for two or even three years). Most efforts simply offered "exposure" to science with the apparent expectation that that would improve the overall quality of students' familiarity with science-related things. This general lack of impact assessment makes the group of NSF-funded projects (printed in italics in the table for easy identification) all the more interesting because nearly all of those did include an attempt at evaluation.

Table 2 shows a frequency count of the projects listed in Table 1 by grade level of the participants and by length of participant exposure. Most efforts (more than 1/2) have been aimed toward high school students and those are the longer-term projects while, at the same time, there is relatively greater emphasis on the shorter-term efforts at the junior high school level and below.

(Text continues on page 183 . . .)

Table 1. Catalogue of Science Education Projects for Minority Students*

ELEMENTARY (6TH-GRADE AND BELOW)

Year	Activity	Cost/ Student	Impact Evaluation**	Comment
	One Day Exposure			
1967-70	Visit to Museum of Science & Industry	5.25	No	
1971 & 74 - present	Visit to Museum of Science & Industry	16.00	No	
1972-75	Visit to Science Center	12.50	Yes	Student attitude change, interviews; teacher questionnaires
1975	Visit to planetarium and museum	1.00	No	
	Brief, Distributed, or Moderate One-Time Exposure (10 Days or Less)			
1969-present	Workshops, field trips, demonstrations, etc., one day per week for six weeks	16.00	Yes	Improvement on science achievement tests
1972-75	Outdoor education	30.00	No	
1973-present	One week of outdoor laboratory school	85.00	Yes	Results not available
1974	Group self-discovery science projects--six one-day sessions	12.00	No	
	Long-term Exposure			
1964-present	Laboratory science club situated in local neighborhood	100.00	No	
1966-70	Training of school supervisors and teachers in more effective science teaching methods	?	Yes	$900/teacher;several measures of impact on classroom including teacher attitude change

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*All information provided by the Office of Opportunity in Science of the American Association for the Advancement of Science.

**Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1968-70	Scientist visits regular class biweekly to conduct science experiments and hold discussions about science topics	120.00	No	
1969	Special classroom instruction on electricity centered around common small appliances for one month	400.00	No	
1970-present	Summer science through hands-on experience of awareness program as part of regular community youth center programming	1.50	No	
1972	Field trips, guided tours, teacher in-service activities for one month	250.00	Yes	Interviews, observation and monitoring with pre-post measures show increased student interest
1973	High school students guided fifth-grade students in group investigations of many environmental science topics for three weeks	15.00	No	
1974-75	Training of teachers in ecology and physical science content and teaching methodology	?	Yes	$545/teacher; pre-post student tests show evidence of greater learning of science content
1974-76	Series of summer and school-year teacher workshops to implement special science curriculum in schools serving predominantly Mexican American students	?	No	$665/teacher
1975-76	Teacher training included compilation of graded science activities with Spanish translation	?	No	$620/teacher; no estimate of number of students affected
*1975-76***	*Teacher training with science activities for bilingual students*	*?*	*In progress*	*$1,250/teacher; first year impact on 25 students per teacher*

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*Other types of evaluation are not considered in this column.

**Italics indicate a project funded by NSF as part of their "Minorities in Science" program and described in detail in this report.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1975	Museum-based general science program for one month	4.00(?)	No	
"Ongoing"	Museum-based general science program	?	No	
	LOWER SECONDARY (7TH-9TH)			
	One Day Exposure			
1971 and 1974-76	Visit to Museum of Science and Industry	16.00	No	
1974-75	*Exposure to one of four techniques to stimulate science interest*	*?*	*No*	
1975	Visit to planetarium and museum	1.00	No	
	Brief, Distributed, or Moderate One-Time Exposure (10 Days or Less)			
1974	Special series of lessons to motivate students to look into engineering as a career choice	80.00	In progress	
	Long-Term Exposure			
1964-present	Laboratory science club situated in local neighborhood	100.00	No	
1971-present	Peer teachers from 1-2 grades above were trained to teach math and science; used as role models	825.00	Yes	15 students admitted to college instead of the usual 2 or 3

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*Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1972-present	Identification and assistance with a highly structured academic reinforcement program from eighth grade through college for students interested in veterinary medicine	42,000.00	No	"The number of minority applicants is now 210% as compared with pre-project years."
1972-76	Special teacher training for potential instructors of seventh and eighth grade educationally uninvolved minority students	?	No	Cost: $9,350/teacher; 42 of 47 teachers have completed program thus far. No measure of student impact.
1974-76	Series of summer and school-year teacher workshops to implement special science curriculum in schools serving predominantly Mexican American students	?	No	$665/teacher
1974-present	Five science course summer programs for college credit	1,400.00	No	
1974-present	Regular science courses augmented with materials, equipment, labs, etc.	125.00	No	
"Ongoing"	Museum-based general science program	?	No	
	UPPER SECONDARY (10TH-12TH)			
	One Day Exposure			
1975	Visit to planetarium and museum	1.00	No	
1975	Science and Mathematics Career Day	17.00	No	

---

*Other types of evaluation are not considered in this column.

Brief, Distributed, or Moderate One-Time Exposure (10 Days or Less)

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1975	Lab experience, field trips, discussion and information about chemical engineering	130.00	No	
	Long-Term Exposure			
1962-64 and 1967	On-campus university program with lectures and labs in science and engineering subjects	300.00	Yes	Designed for underachievers. Found gain in self-esteem, improved academic performance.
1964-present	Laboratory science club situated in local neighborhood	100.00	No	
1968-75	Students exposed to actual scientific work and research at university	275.00	No	
1969-present	Summer math and science courses with field trips, tutor/counselor	410.00	No	38 of 64 participants have entered college; 20 of 26 accepted for start in fall
1969-74	Students from inner-city schools spend summer working with scientists in government oceanographic laboratory	?	None Available	
1969-present	Summer plus follow-up of discussion groups, lectures, lab projects, educational and recreational trips and tutoring/college application assistance	400.00	Yes	Doubled high school rate of college attendance; very low high school dropout rate
1969-72	Special programming in marine ecology, fisheries, aquaculture	6,700.00	No	Many graduates are carrying out duties which are scientifically sophisticated
1969-70	Summer program to interest students in health science careers, prepare them for college courses in science and to develop appropriate teaching materials.	1,000.00	No	A number of alumni have been successful in preprofessional college curricula.

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*Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1970-present	Summer program at university includes course work in mathematics and science with opportunity to experience college life	160.00	No	49% of participants have gone to college, 29% are finishing
1970-present	Summer work in chemistry research lab on an individual project with a full-time university faculty member	700.00	No	Majority of students have gone on to college in science field
1970-present	Creation and testing of special materials which arouse interest in science among students with a poor scientific background	3,000.00	No	Materials presently being used by several colleges
1971	Hands-on exposure to computer as motivation for the solution of technological problems	?	No	
1971-present	University lectures at high school, counseling, tutoring, summer session at university; ultimate enrollment in engineering school with financial assistance	1,250.00	No	Increase in number of minority students entering, being retained and graduating from the engineering program
1971-present	Provides counseling, tutoring and other support services to high school students and follows up at the engineering school	1,600.00	Yes	Enrollment of minority students in university engineering program has doubled with retention rate comparable to non-minority students
1972-present	Summer training of counselors to acquaint them with present and future job opportunities at a local industry	?	No	$200/counselor
1973-75	Provide research experience by working 1:1 with a university research assistant	420.00	No	

---

*Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1973	Lab experiments, field trips, tutors to stimulate interest in science	600.00	No	Lack of selection criteria led to mixed motivation, aptitude and interest
1973	Summer program to provide students with special science experiences in and outside of the classroom	600.00	No	Only portions of the program were favorably received
1974-present	University faculty visits to high school classes and semi-monthly visits of students to the university	1,650.00	No	
1974-75	College-level courses in geosciences with lectures, labs, field trips and guest speakers. Students received $250 scholarships.	480.00	No	Some problems with motivation and interest
1974-present	Intensive studies program with special texts and instructional aids	?	No	
1974-75	Four mini-courses to develop technological literacy and understanding of engineering concepts	100.00	No	
1974-75	Students employed as research assistants to university faculty, exposed to campus life, active in research projects	765.00	No	
1974-present	Enrichment courses and mini-project one day a week for four months	795.00	No	15 of 30 returned till end of program
1974-present	Summer class lectures in the geological sciences with laboratories, field trips and guest lecturers. $200 stipend and possible college credit given	650.00	No	Interest high among participants and faculty

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*Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1974-present	Peer teachers from 1-2 grades above were trained to teach math and science; used as role models	825.00	Yes	15 students admitted to college instead of the usual 2 or 3
1974-75	Summer program to give students interested in health careers first-hand experience with health care implementation	295.00	No	"Several" participants have enrolled in various health-related programs
1974-75	Summer program to encourage students to pursue careers in the geosciences	440.00	No	
1974-76	Series of summer and school-year teacher workshops to implement special science curriculum in schools serving predominantly Mexican American students	?	No	$665/teacher
1974-77	*Career counseling, tutorial assistance, special science projects through high school*	*1,060.00*	*N/A*	*Project completed in June 1977*
1974-77	*Special three-year math and science programming in high school, university visits, projects*	*1,775.00*	*N/A*	*Project completed in June 1977*
1974-75	*Long-term mathematics aptitude and motivation check for vocational high school students interested in engineering*	*1,320.00*	*Yes*	*27 of 37 participants entered engineering school*
1974-75	*Monthly in-service training of guidance counselors to increase awareness of minority high school student problems*	*?*	*No*	
1975	Provide research experience by working 1:1 with a university research assistant	500.00	No	

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*Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1975-76	High school students provided extra sections and additional courses in sciences and communicative skills with lectures, workshops and laboratories	?	No	
1975	Two-week summer campus stay with lectures, laboratories, field trips and conferences with practicing engineers	475.00	No	
1975	Summer training sessions following eleventh and twelfth grades, university provides guidance, tutorials and applications assistance	1,100.00	No	
1975-76	*Summer engineering courses, laboratories field trips at university with school year counseling and bi-monthly university classes. Engineering-related jobs during second summer.*	*1,845.00*	*Not yet*	*Program still in progress*
1975	Exposure of students to summer university engineering careers with field trips and science courses	670.00	No	
1975	High school students exposed to college campus life with lectures on mathematics, geological sciences and discussions of engineering	440.00	No	No dropouts, low absentee rate
1975-present	Academic reinforcement program for students during their entire high school career with summer projects and intensive study	1,740.00	No	
1975-present	Training of teachers to implement an innovative pre-biomedical program for eleventh and twelfth grade	?	No	$1,665 per teacher. Program now being taught in seven high schools

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*Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1976 start	Provide students with an overview of opportunities in the field of engineering and to increase the number of students in the university engineering program.	750.00	N/A	Project began in June, 1976. Participants active in project from eleventh grade through college freshman year.
1976 start	Monthly in-service training of teachers and counselors to increase awareness of minority problems in engineering	?	N/A	$1,265/teacher

COLLEGE/UNIVERSITY

Long-Term Exposure

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1968-present	Provide students with first-hand supervised research experience at a large research facility	?	No	"106 students have successfully completed this program."
1969-70	Summer program to interest students in health science careers, prepare them for college courses in science and to develop appropriate teaching materials	1,000.00	No	A number of alumni have been successful in pre-professional college curricula
1970-present	Creation and testing of special materials which arouse interest in science among students with a poor scientific background	3,000.00	No	Materials presently being used by several colleges

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*Other types of evaluation are not considered in this column.

Year	Activity	Cost/ Student	Impact Evaluation*	Comment
1971-present	Preparation of native American students for science careers through special programming and full scholarships	8,335.00	No	Students deemed unable to handle college-level work
1972-present	Facilitation of learning of biology through audio/visual and other teaching aids	490.00	No	
1973-75	*Summer mini-course in chemistry for university pre-freshmen*	*305.00*	*Yes*	*Large decrease in freshman chemistry failure rate among minority students*
1974-75	Summer program to encourage students to pursue careers in the geosciences	440.00	No	
1974-79	Special training for sophomore biology and chemistry majors to prepare them as researchers in the health professions	8,090.00	No	Participants have presented their research at professional symposia; some have entered medical school
1974-75	Summer program to give participants interested in health careers first-hand experience with health care implementation	295.00	No	"Several" participants have enrolled in various health-related programs
1974-75	*Summer pre-engineering courses to prepare students for entry to engineering schools*	*870.00*	*No*	
1974	*Summer pre-engineering courses to prepare students for entry to engineering schools*	*2,280.00*	*No*	
1976 start	Lectures, workshops, tours and clinical experience to acquaint participants with health career opportunities and provide course work to enhance interest	1,980.00	N/A	Project began January, 1976; participants selected from among freshmen and sophomores who have not declared a major
1976 start	Monthly in-service training of community college professors to increase awareness of minority problems in engineering	?	N/A	$1,265/teacher

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*Other types of evaluation are not considered in this column.

Table 2

Frequency of Science Education Projects by Grade Level of Parcicipants and Length of Project-Participant Contact

	One Day Exposure	Brief Exposure (2-10 days)	Long-Term Exposure	
Elementary School (6th grade and below)	4	4	13	21
Lower Secondary 7th-9th grades	3	1	8	12
Upper Secondary 10th-12th grades	2	1	45	48
College/University	0	0	14	14
	9	6	80	95

The types of approach attempted in these efforts ranged from a single visit to a science museum to programs which streamed participants in science activities over a period of two or more years. Other efforts included:

--Utilization of older students as teachers/guides for younger students
--Special field trips, tours, and projects added to other programs
--The addition of special science topics to regular classroom activities
--Extra coursework/training during the summer
--Special training of teachers to present science topics
--Pairing off of participants with science or engineering researchers for hands-on experience with scientific endeavors.

For any intervention attempt, it's impact, if all other education flow factors remain constant, can be expected to be strongest at the point where it occurs in the education process. A project which seeks to strengthen the science interest of high school students may well succeed at getting some extra proportion of participants to elect science-related subjects or even to remain in high school to the point of graduation, but that increase cannot be expected to be maintained among the proportion of high school graduates who continue on to higher education, since factors other than students' interest become more dominant. The proportionate decrement at various points in the education process in the number of students headed toward science has been roughly accounted for in the Typical Education Flow Pattern diagrams presented in the previous chapter, and thus it is possible to estimate the relative cost per student at a given point in the flow which is equivalent in ultimate outcome to the cost at another point. For native American students, for example, about 1/6 of those who complete grade ten eventually enter higher learning at a four-year institution. Therefore, an intervention attempt which works with students already committed to higher-level learning could theoretically spend six times as much per student and still be cost-equivalent to an effort at the junior high school level. So, it is entirely reasonable for project costs per student to increase as the age of the participants increases, and that is what Table 3 shows. (The above applies to direct attempts to influence student participation, but several projects have tried to influence students indirectly through the special training of teachers and counselors. It is not possible to estimate the cost-per-student of those efforts in the same manner because of the sequential contact with groups of students over many years.)

Table 3

Median Cost-Per-Student of Science Education Projects by Grade Level of Participants and Length of Project-Participant Contact

	One-Day Exposure	Brief Exposure (2-10 days)	Long-Term Exposure
Elementary School (6th grade and below)	$9.00	$23.00	$110.00
Lower Secondary 7th - 9th grades	$8.50	$80.00	$425.00
Upper Secondary 10th-12th grades	$9.00	$130.00	$670.00
College/University	—	—	$1,478.00

However, in addition to dollar cost considerations, the actual or potential "value" of a project depends on the relative impact of the techniques employed and that is the area where the experience of the nearly 100 AAAS projects examined remains virtually mute. Lack of an evaluation of a project's impact results in no ability to estimate the net gain in student science

Table 4

Comparison of Costs-Per-Student for the NSF-Sponsored Minority Science Projects

	Administrative Costs[1]	Participants Actual	Participants Potential[2]	Cost/ Student Actual	Cost/ Student Potential	Effectiveness[3]
Texas A. & I. University (teacher training)	$22,535	450 (18 teachers x 25 students each)	2500[4] (25 x 25 students x 4 yrs.)	$50	$9	10%
Michigan State University (science career incentives)	$ 44,992	?	?	?	?	?
UCLA (improved science contact)	$141,764	80	120	$1,725	$1,180	--[5]
Colorado State University (counseling)	$158,800	150	150[6]	$1,060	$1,060	--[5]
Temple University (engineering contact)	$ 55,286	30	120	$1,845	$ 460	--[5]
Los Angeles County (counselor training)	$ 50,635	3,400 (17 counselors x 200 counselees)	7,200[4] (36 x 200 students x 4 yrs.)	$ 15	$ 2	5%
University of Michigan (chemistry mini-course)	$ 21,242	70	135	$ 305	$ 160	20%
University of North Dakota (pre-engineering training)	$ 29,623	13	20	$2,280	$1,480	10%
Olive-Harvey College (pre-engineering training)	$ 48,300	43	100	$1,125	$ 485	20%
University of Massachusetts (qualify for engineering)	$ 48,875	37	150	$1,320	$ 325	50%

Notes:
1. Total grant award minus one-time start-up costs.
2. Estimate of the number of participants who could be accommodated without appreciable increase in project costs.
3. In terms of proportion of students whose science-related behavior is materially changed. This is a subjective figure based on project-collected data, AIR's observations, characteristics of the target population, and other information.
4. Arbitrary projection of four years of teacher/counselor contact with successive groups of students takes into account a probable decline in effectiveness over time and dilution by reassignment and resignation.
5. Project ongoing; no estimate of effectiveness possible at this time.
6. CSU project objective was to maximize the number of students per staff member during the experimental program.

participation over other kinds of intervention techniques or over no intervention at all. Of the 10 NSF projects which were designed to test intervention strategies (i.e., excluding the Stanford University project), the effectiveness of six can be estimated roughly from project information. (Those estimates and other cost information for the projects are shown in Table 4.) Impact is dependent on two interrelated project elements: participant selection strategies, and the effectiveness of project programming. For example, the University of Massachusetts project selected its participants according to strict criteria of quality and was very successful in its attempts to interest them in an engineering curriculum. Twenty-seven of the 37 participants entered engineering schools following high school completion, whereas only two or three had had pre-project plans to do so. An effectiveness of 50% was ascribed to the project to allow for possible future dropouts. For this project, the potential cost per student (calculated by estimating the number of additional students who could have been accommodated in the program without increasing program costs) of $325.00, coupled with the project's great effectiveness, makes the technique very attractive when compared with other high school intervention strategies carried out at Colorado State University and UCLA no matter how effective the latter may prove to be.

Conversely, the six-fold advantage in cost/effectiveness of the Olive-Harvey approach over the approach of the University of North Dakota suggests that the latter may be inappropriate at the pre-college level since the need to make up extraordinary anticipated deficiencies among the targeted participant population is a direct contributor to North Dakota's potential cost-per-student.

For most of the NSF projects, and for a few of the other projects tabulated by AAAS, a general idea can be gained of the effectiveness of the intervention strategy utilized, but for the overwhelming majority of recent minority science education intervention attempts, the absence of impact evaluation prevents knowledgeable decisions being made about their potential utility.

Exhibits

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EXHIBIT I--PROJECT INFORMATION CHECKLIST

Initiation

Reason for project initiation

Source of idea

Original author
Proponents

Alternatives considered

Whose ideas (by position) went into the proposal; where did it go?
(Trace offices or individuals--who wrote it? Relationship to those who carried it out)

Funding negotiations (what snags and how resolved)

Planning

--what people involved
--what were major issues

Support/Opposition

Personnel selection

--who did it
--on what basis
--how many applicants considered, who were they (backgrounds)
--how employed (full/part-time, salaried/loan, etc.)

Operations

Specifically stated goals and objectives utilized

Fit of project goals with broader institutional context (congruent, new, competitive, etc.)

Treatment plan overview

- --materials development
- --testing procedures
- --placement procedures
- --classroom organization
- --staff development

Management (formal and informal lines)

- --administrative organization in school
- --administrative relations beyond school
- --resource allocation decisions (who did it, on what grounds, etc.)
- --planning (who, how extensive is time-frame)
- --involvement of target groups in management decisions (how approached, how used)
- --evaluation (who does it, how)
- --record-keeping (who, which records, how and where kept)

Cooperation required from outside elements

- --personnel
- --space
- --funds
- --materials
- --other support (printing)

Amount of change required to be "successful" (how determined)

Kinds of change

- --expected
- --achieved

Adaptations

Differences between elements as originally designed and as finally turned out (what and why).

- --goals and objectives
- --treatment
- --emphasis among types of treatment
- --management characteristics
- --project complexity
- --amount and extent of change required
- --place where change was to occur
- --personnel assignments

Near-Term Behavioral Change

Project personnel

- --acquisition of new skills
- --changes in attitude and actions

Participants

- --educational achievement
- --amount of participation
- --attitude toward institution, personnel, subject matter
- --attendance (voluntary or required?)

Unanticipated consequences

- --positive
- --negative

Next Steps

Actual (new proposal, local finding, etc.)

Theoretical (spinoffs, extensions, communication of results)

EXHIBIT II--RESOURCES

A. Individuals

The following people provided the AIR study with information or direction.

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B. Published Materials

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